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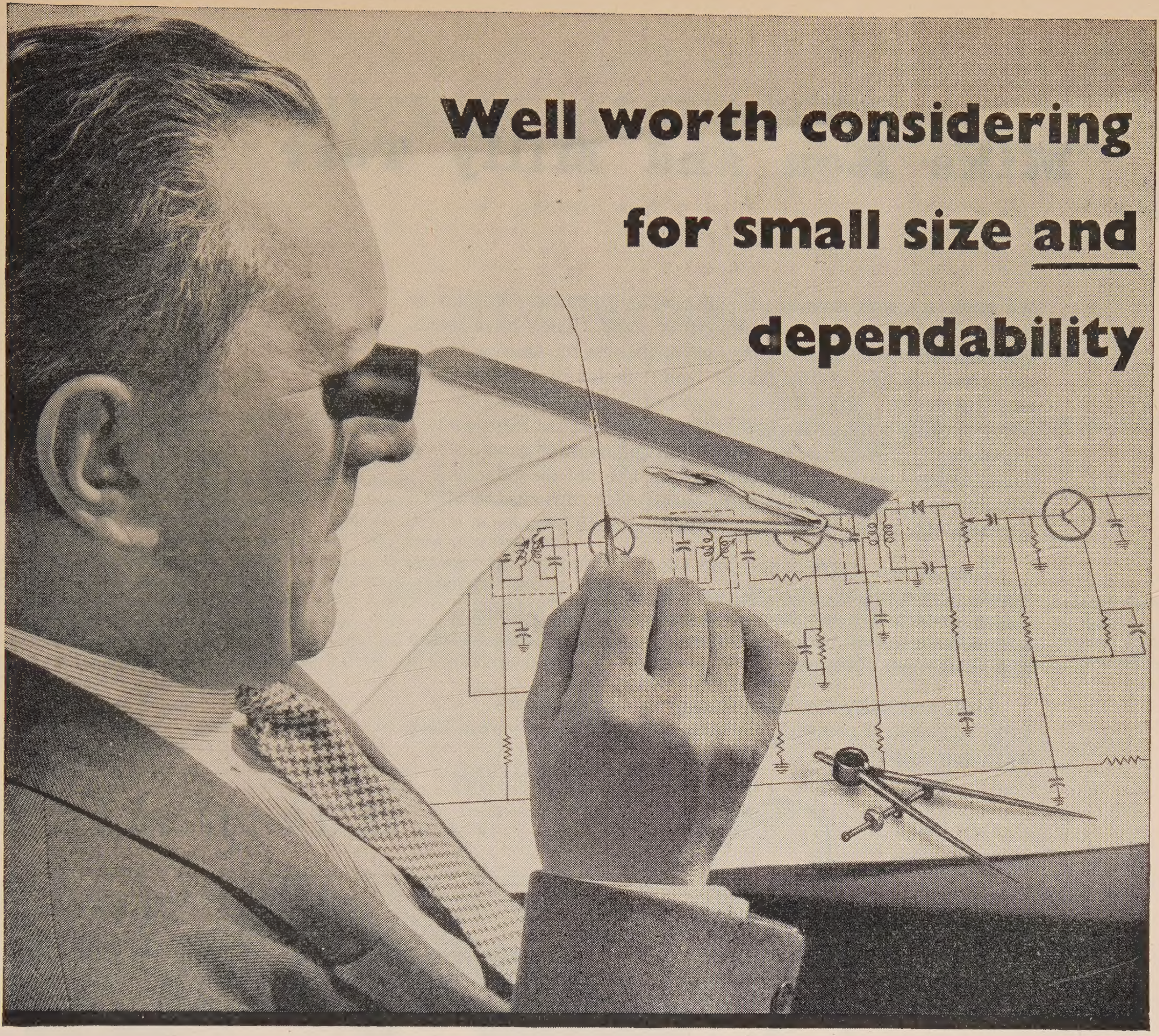

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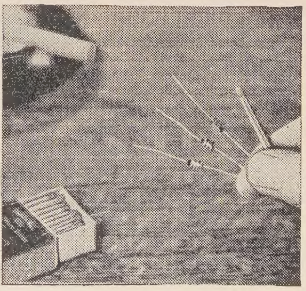

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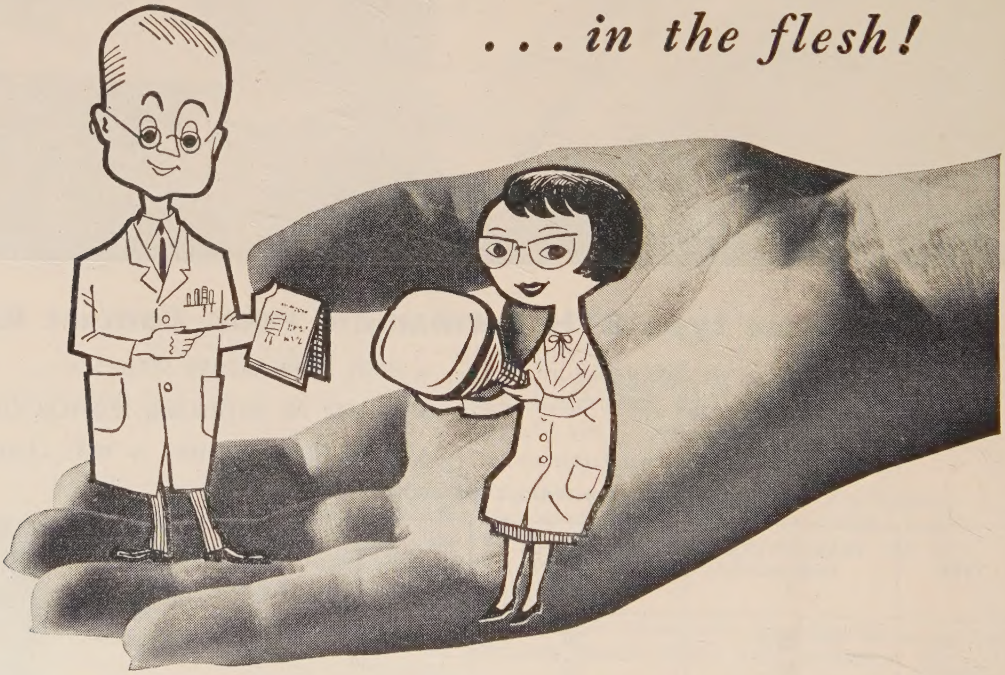

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PHYSICS ABSTRACTS

Volume 62 MARCH 1959 Number 735

MATHEMATICS

512.9 : 530.12

1995. UNION PARALLEL DISPLACEMENT. C.E.Springer.
Rev. Univ. Tucuman A, Vol. 11, No. 1-2, 104-9 (1957).

It is known that if a vector with components λ^α is transported by Levi-Civita parallelism around an infinitesimal circuit in a Riemannian manifold, the change $\Delta\lambda^\alpha$ in the components is zero if, and only if, all of the components of the Riemann tensor vanish. In this paper, union parallelism is introduced. The usual components of connection represented by the Christoffel symbols are replaced by components of connection which appear in the differential equations of union curves with respect to a given rectilinear congruence. It is shown that a congruence may be chosen such that if the vector λ^α is displaced around an infinitesimal circuit in a union parallel manner with respect to this congruence, the vector λ^α returns to its original position.

517.512.4

1996. TSCHEBYSCHEFF [CHEBYSHEV] APPROXIMATIONS FOR BESSEL FUNCTIONS. H.Werner.
Nukleonik, Vol. 1, No. 2, 60-3 (July, 1958). In German.

Interpolation polynomials are given for J_0, I_0, K_0, J_1, I_1, K_1, Y_1, in the range $0 \leq x \leq 8$.

519.24

1997. A SIMPLE CORRELATION MEASURE. J.Taubenheim.
Naturwissenschaften, Vol. 45, No. 17, 413 (1958). In German.

A simple measure of correlation invariant to monotonic transformations is obtained from a correlation method suggested by Rawer (Abstr. 1986/1952).

J.Dutton

ASTROPHYSICS

522.6 : 523.164.42 : 621.396.677

1998. ON THE OBSERVATION OF RADIAL-SYMMETRIC RADIO SOURCES WITH THE MICHELSON INTERFEROMETER. I. G.Elwert and H.Siedentopf.
Z. Naturforsch., Vol. 11a, No. 10, 769-75 (1956). In German.

A discussion, mainly mathematical, as to what properties an interferometer arrangement must have in order to estimate the diameter and intensity distribution of a radio source with a prescribed accuracy. For an accurate determination of the intensity distribution of radial-symmetric cosmic radio sources, the distance between the two aerials of the interferometer system must be sufficiently great. An investigation is made of the degree of error in determining the intensity distribution of radio-source models with zones of constant radiation temperature, due to the use of aerials a finite distance apart. Disk-shaped and ring-shaped sources are first treated and then a combination of disk and ring. The results obtained, in a similar form, are also valid for elliptic distributions.

A.Wilkinson

522.6 : 523.164.42 : 621.396.677

1999. ON THE OBSERVATION OF RADIAL-SYMMETRIC RADIO SOURCES WITH THE MICHELSON INTERFEROMETER. II. G.Elwert.
Z. Naturforsch., Vol. 11a, No. 12, 961-9 (1956). In German.

From the results obtained in Pt I (see preceding abstract), functions are derived for the theoretical intensity distribution of the sun in the r.f. range. Further source models are considered and estimates made of the errors in intensity-distribution determinations due to the finite maximal distance apart of the interferometer aerials. Previous interferometer determinations of the intensity distribution of the sun are critically discussed, including those on m, dm, and cm wavelengths. It is concluded that the maximal separations of the interferometer aerials hitherto used are inadequate and that the measurements only give a rough picture of the sun's intensity distribution, the measurements in the dm-wave range particularly giving too little information concerning its true structure.

A.Wilkinson

523.161

2000. ON THE NATURE OF THE GALACTIC HALO. S.B.Pickelner and I.S.Shklovsky.
Rev. mod. Phys., Vol. 30, No. 3, 935-7 (July, 1958).

In this model the halo is a partially ionized gaseous system with temperature of order 10^4 degrees, with irregular macroscopic motions of order 100 km/sec, and equipartition between magnetic and kinetic energy. From observed non-thermal radio-emission and cosmic-ray densities it is estimated that the field is 6×10^{-6} gauss 1 kpc from the galactic plane and 3×10^{-6} gauss 10 kpc from it. The density 10 kpc from the galactic plane is $0.6 \times 10^{-2}\,\mathrm{cm}^{-3}$, estimated from a hydrostatic balance. Shock waves are considered not to dissipate the motion rapidly (decay time estimated at 25×10^6 years), nor to raise the temperature above about 30 000 degrees, because of the strong magnetic field. Observational data on 21 cm radiation are quoted in favour of the model.

O.Penrose

523.161

2001. ON THE COOLING OF INTERSTELLAR MATTER. E.Schatzman.
Rev. mod. Phys., Vol. 30, No. 3, 1009-11 (July, 1958).

The cooling of an HII region into an HI region is considered with special reference to Seaton's recent estimates of the rate of energy loss due to inelastic collisions of electrons with ions. A critical discussion is also given of a contraction process suggested by Zanstra, and it is concluded that the suggested separation into two phases of equal pressure can play no significant role in HI regions.

R.A.Newing

523.161 : 537.56

2002. COLLISION OF TWO HIGHLY IONIZED CLOUDS OF GAS. F.D.Kahn.
Rev. mod. Phys., Vol. 30, No. 3, 1069-71 (July, 1958).

Numerical cross-section estimates indicate that two gas clouds on colliding will quickly ionize each other. Next, the counter-streaming of electrons will be converted to plasma oscillations almost at once, by a mechanism described previously (Journal of

Fluid Mechanics, Vol. 2, 601, 1957). Finally the proton counter-streaming will also be converted to plasma oscillations (this is demonstrated theoretically using the simplification that the electrons are at rest). A criterion for the relative importance of plasma oscillations and collisions is given, and its modification to allow for the presence of a magnetic field is discussed. O.Penrose

523.164.32

2003. EXAMINATION OF SOLAR BURSTS IN THE CENTIMETRE WAVE REGION. O.Hachenberg.

Z. Astrophys., Vol. 46, No. 2, 67-87 (1958). In German.

Measurements of radiation at wavelengths of 3.2, 10, 15 and 20 cm for a solar burst show a pronounced similarity in structure, and it is concluded that burst radiation in the range 10^3 to 10^4 Mc/s has a continuous spectrum. Spectral intensity distribution in burst radiation is also discussed. R.A.Newing

523.164.4

2004. THE DISTRIBUTION OF THE GALACTIC RADIO EMISSION.

J.E.Baldwin.

Monthly Not. Roy. Astron. Soc., Vol. 115, No. 6, 690-700 (1955).

An analysis is made of the distribution of the integrated radio emission, and it is shown that most of the emission is galactic in origin and arises from a spherical distribution having a radius greater than 10 kps ; the emission per unit volume throughout this spherical region is remarkably constant. A further distribution which accounts for the greater part of the radiation at galactic latitudes less than 30° is found to be consistent with the radio model of the Galaxy proposed by Westerhout and Oort. A comparison of the Galaxy with M_{31} shows that, whilst the extents of the spherical components in the two galaxies are very similar, the emission per unit volume is about six times greater in the Galaxy than in M_{31}.

523.164.8 : 551.594.5

2005. HORIZONTAL MOTIONS IN RADAR ECHOES FROM AURORA. G.F.Lyon and A.Kavadas.

Canad. J. Phys., Vol. 36, No. 12, 1661-71 (Dec., 1958).

A systematic motion of 48.2 Mc/s echoes associated with aurora is found at Saskatoon. The motion is towards the west before midnight and towards the east after midnight, the mean velocity in either direction showing a statistical relation to variations in the earth's magnetic field. No correlation is found between individual echo velocity and magnetic disturbance, and no period of zero velocity is observed. There is also evidence of an ordered relation between motion in the north—south direction and disturbances in the earth's magnetic field.

523.164.85

2006. INVESTIGATION OF THE DRIFTS OF THE EFFECTIVE POINT OF RADIO REFLECTION ALONG A METEOR TRAIN.

M.Srirama Rao and R.L.Armstrong.

Canad. J. Phys., Vol. 36, No. 12, 1601-23 (Dec., 1958).

The concept of the effective point of radio reflection from a meteor train was given on the basis of atmospheric turbulence, on a vertical scale of the order of 100 m to 6 km, in the M-region. Some experimental evidence was provided to support the postulate of its drifting along the train, using meteoric body Doppler radar records, taken on 30.02 Mc/s at South Gloucester, during the Geminid shower periods of 1948-50. The velocities (V_S) of the above drifts in the case of 90 observations were calculated, using the ranges of the observed meteors as obtained from the range—time records taken simultaneously on pulsed radar on 32.7 Mc/s at the Metcalfe Road field station (7.5 km distant). It is found that these velocities tend to have higher values in the case of shorter echo durations and vice versa. Theoretical interpretation of the observed results was attempted. Reasonable assumptions of the ionization distribution along a meteor train and of diffusion rates at different levels in the M region were made to derive the echo durations from different portions of a meteor train. Variation of these echo durations with position on the train was taken into account to calculate the theoretical curves of vertical components of V_S v. total echo durations, in the case of a Geminid shower. The effect of turbulence on echo durations was taken into account to explain the observed results successfully.

523.165 : 537.591.5

2007. INTERPLANETARY MAGNETIC FIELD AND ITS CONTROL OF COSMIC-RAY VARIATIONS. J.H Piddington.

Phys. Rev., Vol. 112, No. 2, 589-96 (Oct. 15, 1958).

A model interplanetary magnetic field is described which may explain some features of solar cosmic-ray increases and also fluctuations in the primary radiation. The main features are as follows: (1) A chromospheric "explosion" occurs at the time of a flare in gas permeated by the sunspot field. The gas, linked with magnetic flux $< \sim 10^{21}$ gauss cm^2, is ejected from the vicinity of the sun. (2) The gas and field remain linked and the latter is so distorted that solar cosmic-rays are released $\sim \frac{1}{4}$-1 hour after the flare. (3) The trailing radial field is drawn out past the earth's orbit to form a magnetic cone with closed ends. The life of the interplanetary field is at least a few months and a number of segments may be built up from different spot fields. The general field may contribute, being extended to largely radial form by a general outward movement of gas. (4) Cosmic rays released after one flare may be influenced by the radial field resulting from a previous flare associated with the same, or perhaps a different, spot group. (5) On February 23, 1956, the magnetic cone enclosing the earth contained irregularities separated by ~ 0.5 astronomical unit, capable of deflecting 15 BeV protons up to ~ 20° and completely scattering 1.5 BeV protons. Cosmic-ray diffusion was anisotropic, the rate being ~ 65 times greater along the field than across the field. The main features of the solar increase may be explained by such a field. (6) Some observed variations of primary cosmic radiation (Forbush-type decreases, 27 day and diurnal variations) may be qualitatively explained by the model. (7) The model may explain aurorae in terms of ions of intermediate energy ($\sim 10^5$ eV) transported from the sun in the magnetic cone which reaches the earth in a day or two and may inclose it for many days or weeks.

523.165

2008. ACCELERATION OF COSMIC RADIATION.

G.S.Murty and R.K.Varma.

Phys. Rev., Vol. 112, No. 5, 1789-92 (Dec. 1, 1958).

Alfvén's model of discontinuous magnetic field variations for the acceleration of cosmic rays by the betatron mechanism is generalized to continuous field variations, with special reference to sinusoidal fields. It is shown that the efficiency of this model is maximum when the "rate of randomization" is equal to the frequency of oscillation of the magnetic field. Also the maximum efficiency is comparable with those of Alfvén's and Parker's models.

523.22

2009. ON THE VORTICES POSTULATED IN VON WEIZSÄCKER' THEORY OF THE ORIGIN OF THE SOLAR SYSTEM. J.Tuominen.

Z. Astrophys., Vol. 46, No. 2, 88-91 (1958).

The vortices are studied on the basis of the hydrodynamical equations of motion. It is shown that the usual procedure of neglecting the squares and products of the disturbance velocities and their derivatives cannot be utilized. There are, however, certain terms in the equations which can be neglected while others cannot.

523.31

2010. MASS OF THE MOON FROM SATELLITE OBSERVATIONS

W.J.Gallagher.

Science, Vol. 128, 1207 (Nov 14, 1958).

The four classical methods of determining the mass of the moon are noted, and a new use of an artificial earth satellite is proposed. The procedure, based on Kepler's law, is outlined, but at present the uncertainties in the observed data preclude an improved estimate of the lunar mass.

523.5 : 550.38

MAGNETIC EFFECTS FROM METEORS. See Abstr. 1942

523.5

2011. OBSERVATIONS FROM AN AIRCRAFT OF THE ZODIACA LIGHT AT SMALL ELONGATIONS. D.E.Blackwell.

Monthly Not. Roy. Astron. Soc., Vol. 116, No. 4, 365-79 (1956).

The need for polarization data for the zodiacal light between elongations 20° and 35° is discussed. It is shown that such data can be obtained by observations from high altitude, and especially from aircraft, under suitable conditions. Measurements of brightness in absolute units and of polarization obtained between elongations 21° and 31° along the ecliptic using a Sunderland aircraft at a height of 9000 ft over the South Pacific Ocean on May 24, 1955 are given. Th zodiacal light axis was then vertical to within 0°.3. The average ecliptic latitude of the axis of symmetry on this occasion was only +0°.17. The data are interpreted in terms of electron densities in interplanetary space, and the effect on the computed electron densities of errors in the data and their interpretation are discussed. The angle between the axis of symmetry of the electron component and the ecliptic for this range of elongation is probably less than 1°

523.74

2012. A POSSIBLE CAUSE OF THE HIGH SOLAR ACTIVITY IN FEBRUARY 1956. H.J.Binge.

Z. Naturforsch., Vol. 11a, No. 10, 874 (1956). In German.

It is suggested that the passage of the solar system through a cloud of magnetized interstellar material may have been responsible or the steep rise in solar activity culminating in the intense cosmic-ray outburst of 23 February. The mechanism outlined is analogous o that observed in the RW Aurigae and T Tauri stars.

D.R.Barber

523.746

2013. BEHAVIOUR OF THE PRESENT SUNSPOT CYCLE.

C.M.Minnis; S.W.Visser.

Nature (London), Vol. 182, 1599-600, 1600 (Dec. 6, 1958).

In disagreement with the previous results of Visser (1954) it is ound that monthly mean values of ionospheric indices I_E and I_{F_2}, show from January 1955 onwards a significant positive correlation vith the rotational mean values of sunspot number. Likewise a imilar agreement exists for the I_{F_2} index during the period, 1947-950, also referred to by Visser. The latter author, in reply, admits he use of unsuitable data (de Bilt I indices), but points out the econdary post-maximal oscillations of the sunspot number with a eriod of ~1 year in 1947-50, which appear to be characteristic of ll cycles, though showing a broad scatter of from 6 to 19 synodic nonths: thus there is no evidence of a regular quasi-annual period.

D.R.Barber

523.75

2014. THE EAST—WEST ASYMMETRY OF SOLAR FLARES AND THEIR RADIO EMISSION. J.S.Hey and V.A.Hughes.

Monthly Not. Roy. Astron. Soc., Vol. 115, No. 6, 605-16 (1955).

The distribution in longitude from central meridian of flares vith associated radio bursts at $\lambda = 4.1$ m, during 1947-50 inclusive, s analysed in relation to high geomagnetic activity. It is concluded hat the asymmetry in the distribution, with greater radio burst emission from flares east of central meridian, appears to be a eneral flare characteristic which may be attributed to absorption nd refraction in the solar atmosphere above the flare. The asymmetry is exphasized in flare regions associated with the occurrence f high geomagnetic activity; it is possible that at least part of the symmetry, and particularly a reduction in radio emission which ppears near central meridian, may be due to the early stages of orpuscular stream emission. It is suggested that an asymmetry n the distribution of numbers of flares is similarly attributable to Hα absorption in an asymmetrical structure of the solar atmosphere bove the flare.

523.75 : 525.3

EFFECT OF SOLAR FLARES ON EARTH SATELLITE 1957 β. See Abstr.1011.

523.755

2015. A STUDY OF THE OUTER CORONA FROM A HIGH ALTITUDE AIRCRAFT AT THE ECLIPSE OF 1954 JUNE 30. . OBSERVATIONAL DATA. D.E.Blackwell.

Monthly Not. Roy. Astron. Soc., Vol. 115, No. 6, 629-49 (1955).

The eclipse of 30 June, 1954 was successfully observed from n open aircraft at an altitude of 30 000 ft in excellent sky conditions. Absolute values of the coronal brightness to a distance of $13^\circ.5$ from he sun and the coronal polarization to a distance of 5° are given, ogether with the sky brightness and polarization and their variation vith altitude. The importance of the sky polarization is discussed. The data are related to those for the zodiacal light.

523.77

016. SPECTROPHOTOMETRY OF THE OUTER CORONA.

C.W.Allen.

Monthly Not. Roy. Astron. Soc., Vol. 116, No. 4, 413-18 (1956).

A low dispersion spectrograph with an occulting bar was used t the solar eclipse of June 30, 1954 to obtain three coronal spectra xtending to six solar radii. Photometric measurements show a light increase of reddening with radial distance. The Fraunhofer ines of the outer corona are faint and an interpretation of their neasured intensities leads to a rather high coronal electron density.

523.77

017. THE Hα EMISSION OF PROMINENCES. J.T.Jefferies.

Monthly Not. Roy. Astron. Soc., Vol. 115, No. 6, 617-28 (1955).

It is shown that Hα radiation from the solar disk is strongly eflected by prominences and is an important component of their adiation. An analysis of their observed Hα emission at the limb ndicates a range of kinetic temperatures of about 10^4 to 2×10^4 deg K nd electron concentrations of about 10^{10} to 5×10^{10} cm^{-3} for stable prominences. Two alternative explanations are given for the double peaked profiles of Hα sometimes observed in solar prominences, depending on whether scattering is coherent or incoherent.

523.877

2018. MAGNETIC FIELD OF A CONTRACTING PROTOSTAR.

L.Mestel.

Rev. mod. Phys., Vol. 30, No. 3, 1020-2 (July, 1958).

The protostar is treated as a stationary uniformly magnetized sphere surrounded by a H I cloud. There is an external magnetic field, parallel at infinity to the star's magnetization. The magnetic field near the star is calculated by equating the magnetic force on the ions and the frictional force due to neutral matter falling past the ions into the star. Near the equator there is a "plasma zone" of high ion density in which the lines of force curve sharply and gravitational and pressure forces on the ions outweigh the frictional force mentioned above. The treatment does not apply to H II zones, nor to rotating systems.

O.Penrose

523.877

2019. VISCOSITY, ELECTRICAL AND THERMAL CONDUCTIVITY OF STELLAR MATERIAL. L.Oster.

Z. Astrophys., Vol. 42, No. 4, 228-62 (1957). In German.

A comprehensive and critical review of methods of calculating the coefficients of viscosity and conductivity, with an extensive bibliography. Numerical results are given for stellar matter (85% H, 15% He) for the temperature range $\Theta = 5040/T = 1.3$ to 0.001, and for the electron pressure range $\log p_e = 5$ to -2.

R.A.Newing

525.3

2020. SATELLITE PARADOX. B.D.Mills, Jr.

Amer. J. Phys., Vol. 27, No. 2, 115-17 (Feb., 1959).

As an artificial satellite gradually descends in a near-circular orbit, its linear velocity increases. Its acceleration in the direction of its motion is found to be the same as if the air-drag force, reversed, were pushing the satellite. An attempt is made to explain this phenomenon by deriving relations between velocity, air-drag and altitude.

525.3

2021. ROTATION OF ARTIFICIAL EARTH SATELLITES.

R.N.Bracewell and O.K.Garriott.

Nature (London), Vol. 182, 760-2 (Sept. 20, 1958).

Recordings of the received radio signal level from the Russian satellites are given. Some of these show fadings which can be attributed to satellite rotation. It is shown that a deviation of the direction of spin from the axis of symmetry results in a precession of this axis, and that for a given deviation this is much less pronounced for disk-like than for rod-like structures (i.e. those having maximum or minimum moment of inertia along the axis). It is suggested that the distribution of battery weight in the base of the cone of Sputnik 3 gave stability by increasing the axial moment of inertia. It was noted that rotational fading was not observed for this satellite. For a disk it is possible to stabilize the axis by a vibration damper tuned roughly to the precession frequency. Means of removing the spin are discussed.

W.T.Blackband

525.6

2022. THE DIURNAL AND THE SEMIDIURNAL ATMOSPHERIC SOLAR TIDE. P.Thrane.

Tellus, Vol. 10, No. 4, 415-29 (Nov., 1958).

World-wide oscillations generated by the sun are examined by applying the hydrodynamical equations to a rotating spherical model atmosphere. The oscillations are described as small perturbations on a static state in which the atmosphere is at rest relative to the earth's surface. Let $\dot{q}$ denote the heat supplied per unit mass and unit time. Let p and α denote perturbations in pressure and specific volume of a particle of air and let the displacement of the particle from its equilibrium position be given by θ, ψ, z, i.e. the variations of its colatitude, longitude and height, respectively. Consider the simplest oscillation of 24-hour period rotating with the sun:

$$\dot{q} = C_q \sin(\Psi + \eta_q), \quad x = C_x \sin(\Psi + \eta_x),$$

where Ψ denotes local time reduced to angle and x denotes any one of the variables, p, α, z, ψ, θ. The amplitudes and phase angles are variable with latitude and height. $\dot{q}$, p, α, z, ψ are symmetric with respect to the equator. It is shown that, if C_q, η_q are given as analytic functions of latitude and height, then the quantities C_x, η_x are determined by the equations of motion, the equation of continuity and the first law of thermodynamics. Considering in like manner the simplest oscillation of 12-hr period rotating with the sun:

$$\dot{q} = C_q \sin(2\Psi + \eta_q), \quad x = C_x \sin(2\Psi + \eta_x)$$

it is found that, when C_q, η_q are given, the C_x, η_x satisfying the above mentioned equations contain an arbitrary function of height, f(Z). The absence in the first case of an arbitrary function which might be adapted to boundary conditions, may partly explain the weak development of the 24-hr wave as a global phenomenon in spite of the marked diurnal period in the heat supply $\dot{q}$. A special case of non-linear equations is considered in order to study certain relations between the 24-hr and the 12-hr wave. A heat supply of 24-hr period of the form $\dot{q} = C_q \sin(\Psi + \eta_q)$ can generate a wave of 12-hr period.

529.786 : 621.373.4

2023. CANADIAN STANDARD OF FREQUENCY. S.N.Kalra, C.F.Pattenson and M.M.Thomson.
Canad. J. Phys., Vol. 37, No. 1, 10-18 (Jan., 1959).

Over the past three years a frequency standard of very high precision was installed in Canada. It is composed of equipment located in three different laboratories in Ottawa, Ontario, but separated by a few miles. Intercomparison of frequency between these laboratories, which is done by sending signals over telephone lines and related techniques, is briefly described. Results indicate frequency stability of about $2:10^{10}$ over short and long periods. Absolute frequency is determined from astronomical observations. Inte national intercomparison is carried out by phase measurement of standard frequency and by observations of time signals; some of th results are presented.

PHYSICS

GENERAL

53

2024. CORRELATION OF HIGH SCHOOL AND COLLEGE GRADES. G.K.Schoepfle and D.L.Arnold.
Amer. J. Phys., Vol. 26, No. 8, 537-9 (Nov., 1958).

Correlation of college grades with high school grades shows that a good grounding in mathematics is essential for success in college physics and that the Ohio State University Psychological Test and the complete high school grades provide good college guidance and planning. Beyond 5 basic courses in high school science, achievement, ability, and interest seem more important than more courses. It is hoped that attempts to interest more students in mathematics and physics will not attract students who lack the proper attitude.

530.1

2025. UNCERTAINTY RELATION AND DIFFRACTION BY A SLIT. G.Beck and H.M.Nussenzveig.
Nuovo Cimento, Vol. 9, No. 6, 1068-76 (Sept. 16, 1958).

Arguments based on the rigorous theory of diffraction of a plane wave by a slit of arbitrary width are applied to discuss the uncertainties as a function of the distance from the slit.

530.1

2026. A SEARCH FOR ANISOTROPY OF INERTIA. G.Cocconi and E.Salpeter.
Nuovo Cimento, Vol. 10, No. 4, 646-51 (Nov. 16, 1958).

One of the possible consequences of the Mach principle is that the asymmetric position of the Galaxy with respect to the Earth induces an asymmetry in inertia. A test of this possibility is proposed. It consists in the microwave measurement of the Zeeman splitting of electron levels having different orientations relative to the direction Earth-Centre of the Galaxy. The isotropy of inertia on the Earth can thus be checked with a precision of about 1 part in 10^{11}.

GRAVITATION . RELATIVITY

530.12

2027. CLOCK PARADOX AND THE PHYSICS OF DISCONTINUOUS GRAVITATIONAL FIELDS. C.B.Leffert and T.M.Donahue.
Amer. J. Phys., Vol. 26, No. 8, 515-23 (Nov., 1958).

The motion of the clocks as represented in a solution of the clock paradox offered by Møller (Abstr. 4121/1952) is studied in detail. It is found that in the non-inertial rest frame of the accelerated clock the free clock suffers discontinuities in velocity whenever the "gravitational field" in that frame abruptly changes. Although these discontinuities occur at points of discontinuity of the metric tensor, examination of a case in which the gravitational field is turned on smoothly reveals that the effect is a real one within the framework of the general theory of relativity. By the principle of equivalence it follows that even in a real gravitational field when that field changes in time velocity-dependent terms in the acceleration of a particle exist. These become impulsive for abruptly changing fields and can even cause acceleration in the direction "opposite" to the field.

530.1

2028. ON GRAVITATIONAL RADIATION DAMPING. A.Trautma
Bull. Acad. Polon. Sci. Ser. Sci. math. astron. phys., Vol. 6, No. 10 627-33 (1958).

It is shown that there exist free gravitational motions which differ from those described by the original formulation of the Einstein—Infeld—Hoffmann method. The problem of the motion of two bodies of equal mass is discussed and on the assumption that the Newtonian motion is circular, the equations of motion up to the 9th order turn out to be of the type

$$\ddot{x} + 2\alpha\dot{x} + w^2(x)x = 0,$$

where $\alpha = \text{const} > 0$. G.Stephens

530.1

2029. ON THE MOTION OF ROTATING BODIES IN THE GENERAL THEORY OF RELATIVITY. W.Tulczyjew.
Bull. Acad. Polon. Sci. Ser. Sci. math. astron. phys., Vol. 6, No. 10 645-51 (1958).

General relativistic equations for the motion of rotating bodies are derived and are used to find the relativistic secular correction to Newtonian motion due to body rotation. G.Stephenso

530.1

2030. AN AXIOMATIC RELATIVITY FOR MICROPHYSICS. J.M.Souriau.
C.R. Acad. Sci. (Paris), Vol. 247, No. 19, 1559-62 (Nov. 10, 1958). In French.

In a development of the author's variational theory, the univers is taken to be a five dimensional variety, topologically equivalent to a tube. The first two approximations give general relativity and the Jordon—Thiry unified theory. A finer approximation introduces wave equations of the Klein—Gordon type. R.A.Newin

530.1

2031. "SEMI-METRIC" GEOMETRY AND THE EINSTEIN—SCHRÖDINGER UNIFIED THEORY. P.V.Grosjean.
C.R. Acad. Sci. (Paris), Vol. 247, No. 19, 1562-5 (Nov. 10, 1958). In French.

A differentiable variety V_n is endowed with three connections, two of which are images one of another, and the third is its own image. V_n is said to be "semi-metric" if inner products are defined only between vectors which belong to spaces which are images one of another. The unified field theory can be expressed very simply in terms of the new geometry. R.A.Newin

530.

2032. GENERAL RELATIVITY: RELATIVE STANDARD MASS, MOMENTUM, ENERGY AND GRAVITATIONAL FIELD IN A GENERAL SYSTEM OF REFERENCE. C.Cattaneo.
Nuovo Cimento, Vol. 10, No. 2, 318-37 (Oct. 16, 1958).

It is shown that the equations of the motion of a free test particle in general relativity, with respect to any physical system of reference, can always have the classical interpretation:

Time derivative of momentum = mass × gravitational field.

The result is reached by means of suitable definitions of the differ ent dynamical quantities relative to the chosen system of referenc and by means of the systematic use of a differential operation that eneralizes the usual absolute differentation. In the gravitational ield there are present three parts: one deriving from a scalar otential, one similar to Coriolis' apparent field, and one part deiving from a vector potential.

530.12

033. STRUCTURE OF PARTICLES IN LINEARIZED GRAVITAIONAL THEORY. R.Sachs and P.G.Bergmann.
hys. Rev., Vol. 112, No. 2, 674-80 (Oct., 1958).

The invariant character is examined of restructions imposed n singularities or other sources of the gravitational fields in the instein—Infeld—Hoffmann theory of motion in general relativity. complete classification is provided of sources that can occur in e linearized theory only, in terms of properties that are invariant nder Lorentz and "gauge" transformations (the latter designation efers to linearized curvilinear coordinate transformations). Exept for several explicitly known solutions, all solutions can be deived from a "supermetric" corresponding to the Hertz potential of lectrodynamics. One method of classification is in terms of gauge-ivariant integrals over spatial closed surfaces completely surounding the particles. The motion of each source is determined by s own intrinsic angular momentum and dipole moment. The reults do not depend on any particular assumed form of the stress-nergy tensor of the sources.

530.12 : 512.9

UNION PARALLEL DISPLACEMENT. See Abstr. 1995

530.12

034. RELATIVITY IN A STATIONARY SPHERICAL OR LLIPTIC SPACE. J.Kronsbein.
hys. Rev., Vol. 112, No. 4, 1384-91 (Nov. 15, 1958).

The fundamentals of the theory of relativity in a stationary pherical or elliptic space are developed in continuation of a prevous communication on the static Einstein space in a manner which nables visualization of relative motion. This particular stationary pace appears to be the natural and simplest generalization of instein's space owing to the existence in both of the set of singulary-free motions previously introduced as Clifford translations. This tationary space is no longer spherically symmetrical in all direcions, and there are shown to be two different types distinguished by ight- and left-handed Clifford translations of the reference systems. ach stationary space when compared with the Einstein space has a ight- or left-handed twist associated with it. The geodesics are istorted, except in a certain preferred direction, as compared with instein's space. This is due to the existence of a gravitational field hich resembles in some ways that illustrated in Minkowski space y the "Einstein elevator". The Lorentz group links all these spaces, o that agreement between observers in any two spaces can be estabished with regard to a moving particle seen by both. Einstein's pace is found to occupy a perferential position as compared with ll the other stationary spaces of this type.

FIELD THEORY . QUANTUM THEORY

530.145

035. THEORY OF DENSITY MATRICES.
K.Husimi, Y.Kitano and T.Nishiyama.
Fortschr. Phys., Vol. 6, No. 1-2, 1-15 (1958).

An account is given of some of the developments in the theory of density matrices as a means of attacking many-body problems. The method of generating functions proposed by Husimi is explained and by means of it the definition of the reduced density matrix is extended to go over to the scheme of second quantization. The authors then derive in this scheme the transport equation of Born and Green, starting from the canonical equation for the temporal change of the reduced density matrix treated as a quantized operator. There follows a discussion of the problem of the evaluation of the density matrix for equilibrium states. Approximation methods for calculating partition functions are outlined beginning with the classical work of Wigner. Other methods, utilizing the formal analogy between the Bloch and Schrödinger equations, which are briefly discussed, include the perturbation methods of Schafroth and others, the path-integral method of Feynman, and the scattering theory approach of Watson. T.R.Carson

530.145

2036. OBSERVATION IN QUANTUM MECHANICS. H.S.Green.
Nuovo Cimento, Vol. 9, No. 5, 880-9 (Sept. 1, 1958).

This paper gives an explanation of how the indeterminacy of a quantum-mechanical observable is removed by the process of measurement. It is pointed out that the observation of an individual microsystem is possible only by means of its interaction with a macroscopic system in a metastable state. An interaction of this kind is studied quantum-mechanically. The model consists of a particle with two spin states which are split and brought into interaction with separate detectors. Each detector comprises two sets of oscillators at different temperatures, which become coupled with interaction with the particle, so that the latter can be detected by a temperature change. It is found that states in which the spin is indeterminate cannot affect either detector, and that they are rapidly suppressed when the interaction is "switched on". After the interaction, the state of the particle is no longer pure, and can no longer be represented by a single wave-function. There is no discontinuity in the transition.

530.145

2037. ON THE CONSISTENCY OF SCHWINGER'S ACTION PRINCIPLE. T.W.B.Kibble.
Nuovo Cimento, Vol. 10, No. 3, 417-27 (Nov. 1, 1958).

The conditions for consistency of the equations of motion and commutation relations derived from Schwinger's action principle are investigated. For consistency, it is, in particular, necessary that the time-derivative of equal-time c-number commutators should vanish. It is shown that, under certain assumptions, the theory is consistent if the interaction terms in the Lagrangian are written in a suitably symmetrized form, identical with that required for invariance under SR, and that in general only theories which are equivalent to such "symmetrized" theories can be consistent.

530.145

2038. ON THE BOUND STATE PROBLEM IN QUANTUM FIELD THEORY. W.Zimmerman.
Nuovo Cimento, Vol. 10, No. 4, 597-614 (Nov. 16, 1958).

A causal and invariant scalar field involving a stable bound state is investigated. A formula for the S-matrix is derived and it is shown that the bound state can be described by a local and invariant field operator. For simplicity only the case of spin-zero particles and bound states is considered; however, the extension to other cases is possible.

530.145

2039. COMPLEMENTARITY AND LOGIC. II. QUANTUM THEORY OF A SIMPLE ALTERNATIVE. C.F.v.Weizsäcker.
Z. Naturforsch., Vol. 13a, No. 4, 245-53 (April, 1958). In German.

See Abstr. 899-900/1956. The von Neumann formulation of quantum mechanics is specialized to the two-dimensional case, in which there are only two possible states of the system. This procedure is interpreted logically and the various physical examples of the abstract mathematics are indicated. Certain basic concepts of von Neumann's interpretation are specialized. G.E.Brown

530.145

2040. COMPLEMENTARITY AND LOGIC. III. MULTIPLE QUANTIZATION. C.F.v.Weizsäcker, E.Scheibe and G.Süssmann.
Z. Naturforsch., Vol. 13a, No. 9, 705-21 (Sept., 1958). In German.

A three-fold quantization of a simple alternative (see preceding abstract) produces the quantum field theory of free particles. Multiple quantization is viewed as an iterated application of the "quantum logic". The two spinor of this theory defines a zero four-vector k^{μ}, which is interpreted as the momentum of a massless particle. The second quantization defines a momentum-space function $\varphi(k^{\mu})$, and the third quantization is the field quantization. Generalizations of this theory are discussed. G.E.Brown

530.145 : 539.17

PARITY CONSERVATION IN STRONG INTERACTIONS. See Abstr. 1757-9

530.145

2041. POISSON BRACKETS IN FIELD THEORY. H.Freistadt.
Canad. J. Phys., Vol. 37, No. 1, 5-9 (Jan., 1959).

Poisson brackets for covariant field theory are defined in such a way as to demonstrate the close connection and ready transition between the classical brackets and the corresponding commutators of quantum theory. The approach of Good (1954) is followed in general; but the questions of tensor algebra are handled differently requiring the introduction of a family of space-like surfaces and their normals. As an illustration, the free Klein—Gordon and Dirac fields are worked out.

530.145

2042. REPRESENTATIONS OF SYMMETRY OPERATORS.
P.G.Federbush and M.T.Grisaru.
Nuovo Cimento, Vol. 9, No. 5, 890-4 (Sept. 1, 1958).

Explicit representations in terms of the field variables are given for the charge conjugation, space inversion, and time reversal operators, for the case of free fields. These expressions are generalized to the case of coupled fields.

530.145

2043. SUBSIDIARY CONDITIONS IN COVARIANT THEORIES.
P.G.Bergmann and A.I.Janis.
Phys. Rev., Vol. 111, No. 4, 1191-200 (Aug. 15, 1958).

The effect that coordinate conditions and similar conditions will have on the formal properties of covariant theories has been investigated. Two distinct types of coordinate condition were included, those involving first derivatives of the field variables (such as the gauge condition of Lorentz and the coordinate conditions of De Donder) and those algebraic in the field variables (of which the Coulomb gauge is an example). It is found that with either type of coordinate condition one can construct a variational principle, or a Hamiltonian formalism, which leads to physically meaningful field equations if associated with appropriate initial conditions on a space-like hypersurface. Thus the existence of a properly set Cauchy problem is always assured. It had been found previously that the infinitesimal invariant transformations of covariant theories form a group and that the coordinate (and similar) transformations represent a normal subgroup. The members of the resulting factor group are in one-to-one correspondence with the true observables of the theory, those dynamical variables which alone possess intrinsic significance without reference to a particular frame of description and whose commutator algebra is presumably reflected in the commutators of the corresponding Hilbert operators of the quantized theory. In this paper, the appropriate transformation groups (and their subgroups and factor groups) of a theory with either type of coordinate condition are established. It is found that in any of these versions the theory will yield the same observables with the same commutator algebra. One may therefore hope that a quantization scheme based on a theory with subsidiary conditions will be free of the arbitrariness involved in the choice of particular conditions.

530.145

2044. QUANTUM FIELD THEORIES WITH COMPOSITE PARTICLES AND ASYMPTOTIC CONDITIONS. R.Haag.
Phys. Rev., Vol. 112, No. 2, 669-73 (Oct., 1958).

The connection between the Nishijima—Zimmermann method and the Ekstein method of treating collision processes between composite particles in quantum field theory is given. Starting from the point of view that the field is a local observable, the "asymptotic conditions" are proved and generalized.

530.145

2045. COMMUTATION RELATIONS BETWEEN DIFFERENT FIELDS. G.Lüders.
Z. Naturforsch., Vol. 13a, No. 4, 254-60 (April, 1958). In German.

The problem is analysed on the basis of the postulate that local interaction Hamiltonians lead to local field equations. It is shown that besides the normal case (anticommutativity of different Fermi fields, commutativity of all other fields), there can be other solutions. All these solutions are generated from the normal case by a sequence of transformations of field operators, of a type first studied by Klein. The T.C.P. theorem holds in all these cases, if it holds in the normal case.

530.145

2046. INVESTIGATION OF PARTICLE-LIKE SOLUTIONS OF THE NONLINEAR SCALAR FIELD EQUATION.
V.B.Glasko, F.Leryust, Ya.P.Terletskiĭ and F.Shushurin.
Zh. eksper. teor. Fiz., Vol. 35, No. 2(8), 452-7 (1958). In Russian.

The relation between the field energy of particle-like solutions of the nonlinear equation for a complex scalar field and the equation parameters and frequency of the oscillations is investigated. The first three particle-like solutions are derived and the relevant mass spectrum is analysed by numerical integration for the case of the simplest cubic nonlinear term. Under some reasonable physical assumptions the spectrum is found to be finite.

530.145 : 537.56

2047. DESCRIPTION OF SYSTEM OF INTERACTING PARTICLES BY MEANS OF GREEN'S FUNCTION. L.Kobelev.
Fiz. Metallov i Metallovedenie, Vol. 6, No. 2, 354-6 (1958).
In Russian.

The concept of a "collective" Green's function is introduced for an assembly of interacting particles, and the formulation of such a function is discussed in terms of the density matrix. Specifically, for an electron gas the Green function is related to the statistical mechanical parameters characterizing the assembly.

J.W.Gardner

530.145 : 537.56

2048. DISPERSION RELATIONS FOR ELECTRONIC PLASMA.
A.Voloshinskiĭ and L.Kobelev.
Fiz. Metallov i Metallovedenie, Vol. 6, No. 2, 356-8 (1958).
In Russian.

The quantization of a plasma theory previously reported (see preceding abstract) is adumbrated. The method of Schwinger (Abstr. 64-5/1952) is adapted to formulate the quantized collective Green functions, and their evaluation by the method of functional integration is briefly discussed. J.W.Gardner

530.145

2049. AN ALTERNATIVE METHOD OF QUANTIZATION: THE EXISTENCE OF CLASSICAL FIELDS. J.A.Crawford.
Nuovo Cimento, Vol. 10, No. 4, 698-713 (Nov. 16, 1958).

A new method of quantization, applicable to an arbitrary physical system, is presented. For systems with a classical analogue, the introduction of quantized canonical variables proceeds without the elimination of the corresponding unquantized variables (although the Liouville equation is in general modified). These remain as legitimate physical observables having the same expectation value as, and no greater dispersion than, their quantized counterparts. Their (non-negative definite) joint distribution in phase space then determines the state of the system. In the case of bosons interactin only with external fields or sources, the unquantized fields continue to satisfy the deterministic equations of motion of the unquantized theory. It seems significant that classical relativistic fields with external sources are not eliminated by the process of quantization. All the observable predictions of quantum theory are identically reproduced and no new results are obtained. This method of quantization is therefore an alternative to the usual one. A natural extension of the theory yields a deterministic model for direct boson—boson interactions (e.g. pion electrodynamics), free of mathematical divergences.

530.145

2050. ON A POSSIBLE LIMIT OF APPLICABILITY OF QUANTUM ELECTRODYNAMICS. D.I.Blohinčev.
Nuovo Cimento, Vol. 9, No. 6, 925-9 (Sept. 16, 1958).

The processes competing with electromagnetic ones at high energies are considered. It is shown that such processes may be those involving four-fermion interactions.

530.145

2051. FORM FACTORS IN QUANTUM ELECTRODYNAMICS.
S.D.Drell and F.Zachariasen.
Phys. Rev., Vol. 111, No. 6, 1727-35 (Sept. 15, 1958).

The electromagnetic form factors of an electron in pure quantum electrodynamics are analysed with the techniques of dispersion relations. The viewpoint is adopted here that no subtraction are required in the construction of dispersion relations for the electromagnetic vertex. This leads to coupled integral equations fo the form factors in terms of other physical amplitudes; electron—positron scattering, for example. The relation between this and the usual perturbation approach to quantum electrodynamics, and the validity and consequences of the "no-subtraction" philosophy, are discussed.

530.14

2052. GAUGE-INVARIANT QUANTUM ELECTRODYNAMICS.
I.Goldberg.
Phys. Rev., Vol. 112, No. 4, 1361-6 (Nov. 15, 1958).

Electrodynamics is quantized without resort to subsidiary conditions. The quantization is carried out by identifying quantum commutators with the commutators of a classical transformation group related to the canonical transformations. The resulting theor is completely gauge invariant, and Maxwell's equations hold as operator equations. The quantization of both electromagnetic and electron fields is carried out in terms of gauge-invariant quantities For the Dirac field the observables satisfy commutation relations. The anticommutation rules satisfied by the field variables must be deduced from the commutators of observables. The resulting theor is completely equivalent to the usual quantum electrodynamics.

530.14

2053. CONSISTENCY OF QUANTUM ELECTRODYNAMICS.
K.A.Johnson.
Phys. Rev., Vol. 112, No. 4, 1367-70 (Nov. 15, 1958).

The proof of the statement "At least one of the renormalization constants in electrodynamics is infinite" is examined in the light of perturbation theory and the gauge invariance of electrodynamics. The essential result used to derive the statement is found not to reproduce perturbation theory at least in a simple way. On the basis of gauge considerations a conjecture is proposed which provides a modified essential result and which is found to reproduce perturbation theory. Even if the modified result could be rigorously established, it would not lead to the statement that any gauge-independent quantity is infinite. In fact, the combined results would establish only the statement that the use of gauges where the exact electron "wave-function" relative to the "wave-functions" for a free electron is a constant, is not consistent.

530.145

2054. ELIMINATION OF GHOSTS IN PROPAGATORS.

P.J.Redmond.

Phys. Rev., Vol. 112, No. 4, 1404-8 (Nov. 15, 1958).

Within the general framework of perturbation theory a method for calculating modified propagators in terms of proper Feynman diagrams is derived. This method differs from previous approaches in that one insists that the propagator have the correct analytical behaviour as a function of p^2. As a result one gets an expression for the propagator which is similar to a conventional term-by-term perturbation theory expansion except that it is only necessary to consider proper diagrams and that the iteration of the proper diagrams is represented by a damping factor. As an example, the meson propagator for a pseudoscalar meson coupled to nucleons with a pseudoscalar coupling is approximated by considering only the lowest order proper diagram, a nucleon-antinucleon bubble. The resulting expression for the propagator has the following interesting properties: (1) by construction it has the proper analytical behaviour as a function of p^2; (2) the result has a singularity at $g^2 = 0$ when considered as a function of g^2; (3) the wave-function renormalization is finite. These three properties are intimately connected and when this connection is realized it is easy to understand why the usual methods of expressing propagators in terms of proper Feynman diagrams leads to ghosts. It is the purpose of this paper to understand this connection and to indicate how it is possible to take into account consistently the iteration of proper Feynman diagrams without ever having ghosts appear. It is also found that an asymptotic expansion valid in the region $g^2 = 0$ is possible and that this asymptotic expansion is identical with the perturbation theory series.

530.145

2055. NON-LOCAL STRUCTURE OF FIELD THEORIES WITH NON-RENORMALIZABLE INTERACTION. W.Güttinger.

Nuovo Cimento, Vol. 10, No. 1, 1-36 (Oct. 1, 1958).

Quantized field theories of the second kind, the so-called non-renormalizable theories, are investigated. It has recently been shown that a number of those theories actually can be renormalized. The author shows that field theories of the second kind, pertaining to derivative couplings, possess non-local structure. The full recoil neutral PS-PV theory in its non-linear form is discussed. The non-localizability of both the unrenormalized and the renormalized theories is due to the fact that the infinite set of topologically independent direct interactions, which characterizes PS-PV theory, is equivalent to a new type of indirect interaction. The non-localizability manifests itself in an indeterminacy in space-time of the light-cone. This indeterminacy can be interpreted in terms of a statistical spread in space—time of the positions of two interacting point-nucleons over a space—time volume the size of which is determined by the coupling constant $|g|$ of the linear version of PS-PV theory. The length g loses its meaning as a coupling in the non-linear formalism in favour of the nucleon mass and plays thus the role of a fundamental structure constant. In particular, $|g|$ determines the region in which the equivalence theorem and the $1/r^3$ potential become invalid and repulsive-core potentials begin to act. In virtue of the oscillatory behaviour of the non-tempered momentum space operators in the high energy region, positive-definiteness conditions can be established only for regions $|k_\nu^2| \lesssim |1/g^2|$ and $|x_\nu^2| \lesssim |g^2|$. The non-localizability is concentrated in these domains and $|g|$ seems to play the role of the meson Compton wavelength. A new interpretation of the non-linear PS-PV theory is suggested. It is conjectured that also β interactions give rise to non-local structures. Multiple propagators are introduced to render the formal coupling constant expansions in theories of the second kind mathematically meaningful without producing non-renormalizable infinities. Arguments are advanced against the mathematical consistency of the concept of creation (annihilation) and localizability of more than one point-particle at a single space—time point.

530.145

2056. ON THE UNIVERSAL FERMI INTERACTION.

R.J.Blin-Stoyle.

Nuovo Cimento, Vol. 10, No. 1, 132-5 (Oct. 1, 1958).

It is pointed out in connection with a universal Fermi interaction that conservation of axial vector current does not ensure non-renormalization of the axial vector coupling constant for strongly interacting particles. A discussion is given of possible renormalizing processes and their effects.

530.145

2057. ON THE PROOF OF THE ABSENCE OF RENORMALIZATION OF THE CONSTANT IN THE VECTOR-VARIANT OF β-INTERACTION. B.L.Ioffe.

Nuovo Cimento, Vol. 10, No. 2, 352-4 (Oct. 16, 1958).

It is proved that the vector coupling constant suffers no renormalization if, following Feynman and Gell-Mann, the β-decay Hamiltonian is taken as

$$\begin{cases} H = G_\nu[\bar{\psi}\gamma_\mu\tau^+\psi + 2i(\varphi^+T^+\nabla_\mu\Phi) - 2i(\nabla\Phi^+)T^+\varphi]I^\mu, \\ I_\mu = \frac{1}{2}\bar{\psi}_e\gamma_\mu(1+\gamma_5)\psi_\nu, \end{cases}$$

and

$$H = G_\nu[2\bar{\psi}_\Sigma\gamma_\mu T^+\psi_\Sigma + i(\varphi_k^+\tau^+\nabla_\mu\varphi_k - (\nabla_\mu\varphi_k^+)\tau^+\varphi_k) + \bar{\psi}_\Xi\gamma_\mu\tau^+\psi_\Xi]I_\mu + \text{c.c.}$$

530.145

2058. TWO-STAGE MODEL OF FERMI INTERACTIONS.

N.Byers and R.E.Peierls.

Nuovo Cimento, Vol. 10, No. 3, 520-4 (Nov. 1, 1958).

The model of Fermi interactions which involves an intermediate charged boson of spin one is formulated and found to be capable of reproducing all the results of the direct interaction theory with A and V coupling provided the mass of the intermediate particle is sufficiently large. The only apparent difficulty for the model is the predicted radiative decay of the muon.

530.145

2059. VELOCITY-DEPENDENT FEATURES OF A STATIC NUCLEON—NUCLEON POTENTIAL. G.Breit.

Phys. Rev., Vol. 111, No. 2, 652-66 (July 15, 1958).

The consequences of assuming a pseudoscalar classical field with pseudoscalar coupling are considered in a static approximation. Virtual pair formation of nucleon—antinucleon pairs is not calculated but it is supposed that it gives rise to an attraction. The interaction is being studied mainly in order to see what features of commonly assumed static potentials may not apply. The quantitative features of the derived interaction are not expected to correspond to the physical one. The qualitative character of deviations from static potential behaviour is believed, however, to have a bearing on the velocity-dependent features of the actual interaction. The work neglects some of the effects of the exclusion principle caused by the population of negative-energy states. Some of the qualitative non-static features are: (a) different magnitudes of the spin—orbit potential in even and odd states, (b) inadequacy of the usual procedure of the insertion of e^2/r in the wave equation for the calculation of phase shifts in p—p scattering; this inadequacy is connected with the fact that the standard form of the wave equation is obtained only after a transformation of a wave equation in which e^2/r has a direct significance as a potential energy, (c) velocity (energy) dependence of core radii and of magnitude of effective potentials, (d) occurrence of quadratic term in the tensor interaction in the effective potential even though in an earlier stage of the calculation only linear terms are present.

530.145

2060. CHARGE SYMMETRY OF WEAK INTERACTIONS.

S.Weinberg.

Phys. Rev., Vol. 112, No. 4, 1375-9 (Nov. 15, 1958).

The invariance of strong interactions under G, the product of charge symmetry and charge conjugation, has important consequences for strangeness-conserving lepton interactions. According to the G-transformation properties of the strongly interacting "currents", one may divide the primary weak interactions into two classes. The first class includes the conventional nucleon—lepton Fermi interaction, and is the only class that contributes to the β-decay coupling constants. Unambiguous tests for the existence of second-class interactions include: (a) induced scalar term in μ^- absorption, (b) inequality of certain small correction terms in B^{12} and N^{12}, or in Li^8 and B^8 β-decay, (c) inequality in rates of $\Sigma^\pm \to \Lambda^0 + e^\pm + \nu$. Absence of second-class interactions would indicate a deep relation between isotopic spin and weak interactions; for example, the recent

Feynman–Gell-Mann theory predicts that all vector weak interactions are first class. The presence of second-class interactions would mean that the usual Fermi interaction is insufficient, and must be supplemented by terms involving strange particles. Some general remarks are also made about the relations between (l^-,ν) and (l^+,ν) processes, and the following useful theorem is proved: no interference between V and A may occur in any experiment which treats both leptons identically and in which no parity nonconservation effects are measured, provided that one may neglect the mass and charge of the leptons.

530.145

2061. ON THE THEORY OF WEAK INTERACTIONS. I.
Yu.A.Gol'fand.
Zh. eksper. teor. Fiz., Vol. 35, No. 1(7), 170-7 (1958). In Russian.

A scheme of a universal four-fermion interaction is proposed which differs from the usual schemes by the method of introduction of quantized fields in the theory. Electron and positron β-decays are described by different Fermi interaction variants. The CPT theorem is invalid but the theory is invariant with respect to CP, CT and PT transformations. Various experimental and theoretical consequences are discussed.

530.145

2062. ON THE THEORY OF WEAK INTERACTIONS. II.
Yu.A.Gol'fand.
Zh. eksper. teor. Fiz., Vol. 35, No. 3(9), 726-30 (1958). In Russian.

A scheme is proposed in which the non-Hermitian weak-interaction Hamiltonian H_W is a constituent part of the Hermitian total Hamiltonian operating in "doubled" Gilbert space.

530.145

2063. ON THE GEOMETRICAL REPRESENTATION OF SPINOR QUANTITIES. O.Beaufays.
Bull. Acad. Roy. Belgique Cl. Sci., Vol. 44, No. 6, 555-76 (1958). In French.

The relations between the tensor quantities associated to a given spinor in the usual Minkowski space–time are geometrically interpreted by establishing a correspondence between the given spinor and a point in the space E_3. J.Lascoux

530.145

2064. ON A POSSIBLE GEOMETRICAL INTERPRETATION OF GAUGE TRANSFORMATIONS. J.Rzewuski.
Nuovo Cimento, Vol. 9, No. 6, 942-9 (Sept. 16, 1958).

It is shown that the geometrical origin of gauge transformations may be found if one considers the eight-dimensional spinor space rather than the four-dimensional vector space as the basis of a physical theory. The connection of the spinor space with the vector space is studied in some detail. It is shown that the irreducible representations of an enlarged group of transformations of the spinor space contain all the transformation types assumed for fundamental particles, including their isotopic spin characterization.

530.145

2065. AN EXPLICIT SOLUTION OF THE THIRRING MODEL.
V.Glaser.
Nuovo Cimento, Vol. 9, No. 6, 990-1006 (Sept. 16, 1958).

The two-dimensional model of a relativistic theory proposed by Thirring (Abstr. 2758/1958) is solved by displaying the field operator ψ as an explicit functional of the corresponding incoming field. The S-matrix (without external sources) is found to be of the form $S = \exp[iQ_1Q_2]$, where $Q_{1,2}$ are two constants of the motion. The S-matrix is unitary, but gives rise only to a relative change of phase of the plane waves associated with the colliding particles, all the cross-sections being equal to zero. After the renormalization, all the matrix elements of the field operator turn out to be finite analytic functions of the coupling constant. An apparent discrepancy with the results of Thirring is discussed.

530.145

2066. ON INTERACTING SPINOR FIELDS IN ONE DIMENSION.
W.Thirring.
Nuovo Cimento, Vol. 9, No. 6, 1007-15 (Sept. 16, 1958).

The physical significance of the exact solution of interacting spinor fields in one space dimension is discussed. It is argued that the absence of ghosts in this theory is connected with the fact that there is only a field but no infinite charge renormalization. See also preceding abstract.

530.145

2067. ON THE COMPATIBILITY OF RELATIVISTIC WAVE EQUATIONS FOR PARTICLES OF HIGHER SPIN IN THE PRESENCE OF A GRAVITATIONAL FIELD. H.A.Buchdahl.
Nuovo Cimento, Vol. 10, No. 1, 96-103 (Oct. 1, 1958).

It is known that the equations for particles of spin $\geq \frac{3}{2}$ become inconsistent when electromagnetic interactions are introduced by the usual rules. An analogous problem is that of the effect of the introduction of gravitational fields on the consistency of the equations. The "natural generalization" of the usual field equations for particles of spin $\frac{3}{2}$ is here considered in detail, and it is shown that the equations are compatible if and only if the Riemann space in which the spinor field is contemplated is an Einstein space. This result is discussed.

530.145

2068. ON THE CAUSAL PROPAGATION FUNCTION OF A DIRAC FIELD. E.Ferrari and G.Jona-Lasinio.
Nuovo Cimento, Vol. 10, No. 2, 310-17 (Oct. 16, 1958).

It is shown that the causal propagation function of a Dirac field can be split in two functions which satisfy a system of two integral equations similar to the couple of Low equations for the symmetrical charged fixed-source meson theory, in the one-meson approximation. These equations are solved and discussed.

530.145

2069. DIRAC AND GÜRSEY EQUATIONS FOR BOSONS.
J.Fiutak.
Nuovo Cimento, Vol. 10, No. 2, 292-9 (Oct. 16, 1958).

The aim of this paper is to illustrate a possibility of writing the field equations in a new algebraic form. The wave equations for bosons have been obtained in terms of of 16-dimensional Clifford algebra C_4, and alternatively, in connection with the Gürsey (Abstr. 4842/1956, 2778/1958) formalism, in terms of the 4-dimensional Clifford algebra C_2.

530.145

2070. ON THE GROUP STRUCTURE OF ELEMENTARY PARTICLES. F.Gürsey.
Nuclear Phys., Vol. 8, No. 6, 675-91 (Nov. [2], 1958).

An attempt is made to account for the group structure of elementary particles by assuming that they are obtained by combining a limited number of basic fields. It is shown that if the basic fields are all taken to be fermions, one needs three fields to account for the continuous group structure only, but four fields are necessary if distinct operations for C and P are to be incorporated in the scheme. On the other hand, a model with half the number of independent field components can describe the group structure correctly if both bosons and fermions are taken as basic fields, their common feature in this case being that they are all strange fields. Difficulties inherent in such schemes are discussed.

530.145

2071. FOLDY–WOUTHUYSEN TRANSFORMATION. EXACT SOLUTION WITH GENERALIZATION TO THE TWO-PARTICLE PROBLEM. E.Eriksen.
Phys. Rev., Vol. 111, No. 3, 1011-16 (Aug. 1, 1958).

The Dirac Hamiltonian for a particle in a nonexplicitly time-dependent field is converted to an even Dirac matrix by means of a single canonical transformation. When the interaction term is an odd Dirac matrix, the transformed Hamiltonian is expressed in a very simple form. An exact transformation is also found for two-particle wave equations of Breit's type. The transformed Hamiltonian is then a uU-separating matrix, in Chraplyvy's sense. In the non-relativistic limit, expansions in powers of 1/m or 1/c are made. The approximate wave equations are in agreement with previous transformation results.

530.145

2072. PROJECTIVE OPERATORS IN ELEMENTARY PARTICLE THEORY. F.I.Fedorov.
Zh. eksper. teor. Fiz., Vol. 35, No. 2(8), 493-500 (1958). In Russian.

Projective matrices (dyads) describing any possible state of a particle with an arbitrary spin are set up with aid of minimal polynomials of the relativistic wave-equation matrices and the spin matrices. The main physical quantities (energy-momentum, current-charge, transition probability) can be directly expressed in terms of these projective operators in an invariant manner (irrespective of the choice of the representation basis). As a result, calculation of various effects for any type of a particle with spin reduced to the evaluation of the traces of certain combinations of the matrices. As applications of the method the general conditions of definiteness of energy and charge for particles of a single mass are derived and a simple deduction is presented for the general commutation relations for particle of an arbitrary spin.

530.145

2073. BEHAVIOUR OF AN ARBITRARY-SPIN PARTICLE IN AN EXTERNAL MAGNETIC FIELD. V.S.Popov.
Zh. eksper. teor. Fiz., Vol. 35, No. 4(10), 985-8 (1958). In Russian.

A method of "separation", proposed by Feynman (Abstr. 9268/1951), is employed to solved the problem of change, in an external field, of the polarization of a particle possessing a magnetic moment.

530.145

2074. ON THE SECOND ORDER WAVE EQUATION OF THE FERMIONS. G.Marx.
Nuclear Phys., Vol. 9, No. 2, 337-46 (Dec. [1], 1958).

Following the suggestions of Feynman some problems were considered in connection with the description of fermions by a second-order wave equation, e.g. the problem of interactions. The possibility of the description of isodoublet fermions by a four-component spinor field is demonstrated. The latter method eliminates some difficulties in connection with forming the commutation rules. The transformation properties of the second-order equation re analogous to those of the new non-linear Heisenberg equation.

530.145

2075. A GENERALIZATION OF THE PERTURBATION METHOD OF WENTZEL—KRAMERS—BRILLOUIN, APPLIED TO CALCULATE THE ENERGY OF A NUCLEON IN ITS MESON FIELD.
.Mandelbrojt.
C.R. Acad. Sci. (Paris), Vol. 247, No. 12, 871-3 (Sept. 22, 1958).
n French.

A generalization of the W.K.B. method is given, enabling an pproximate solution of two simultaneous differential equations to e obtained. It is employed to calculate the energy of a nucleon, using the symmetric scalar meson theory. P.M.Davidson

530.145

2076. STRONG COUPLING NUCLEON'S PROPAGATOR.
.M.Garrido.
Nuovo Cimento, Vol. 9, No. 5, 822-5 (Sept. 1, 1958).

An approximation method is given for a solution to the equation f the propagator of the stationary nucleon strongly coupled to the pion field. As an example, the procedure is applied to the well known case of neutral pions.

530.145

2077. PHENOMENOLOGICAL THEORY OF THE S MATRIX AND T, C AND P INVARIANCE. II. J.Werle.
Nuovo Cimento, Vol. 9, No. 6, 1091-106 (Sept. 16, 1958).

Contains some applications of the general phenomenological heory of the transition matrix which was given in Pt I (Abstr. 54/1959). Besides a general discussion of various physical relations which ollow from the T, C and TCP invariance requirements the examples of K_{μ_3} and hyperon decays are studied in some more detail.

530.145

2078. DISPERSION RELATION FOR POTENTIAL SCATTERING.
.Gasiorowicz and H.P.Noyes.
Nuovo Cimento, Vol. 10, No. 1, 78-89 (Oct. 1, 1958).

A dispersion relation for the scattering of a Klein—Gordon particle by a fixed static interaction is derived. The dispersion relation is valid only for momentum transfers less than a given limit determined by the behaviour of the interaction at large distances. The dependence of this limit on the mass spectrum is discussed, and it is found that if the system admits sufficiently exothermic inelastic processes, the derivation fails even in the case of forward scattering.

530.145

2079. ANALYTIC PROPERTIES OF SCATTERING AMPLITUDES AS FUNCTIONS OF MOMENTUM TRANSFER. H.Lehmann.
Nuovo Cimento, Vol. 10, No. 4, 579-89 (Nov. 16, 1958).

Scattering amplitudes are shown to have analytic properties as functions of momentum transfer. The partial wave expansions which define physical scattering amplitudes continue to converge for complex values of the scattering angle, and define uniquely the amplitudes appearing in the unphysical region of non-forward dispersion relations. The expansions converge for all values of momentum transfer for which dispersion relations have been proved.

530.145 : 539.12

TIME REVERSAL IN COLLISION PROCESSES.
See Abstr. 1647

530.145

2080. SERIES EXPANSIONS AND VARIATIONAL METHODS FOR THE ENERGY OF A SYSTEM OF FERMIONS. R.J.Eden.
Nuclear Phys., Vol. 9, No. 1, 65-73 (Nov. [3], 1958).

The relation between a variational method and a formally complete perturbation series for the energy of a finite system of fermions is studied. If certain assumptions about convergence are valid the variational method minimizes the size of the sum of correction terms in the perturbation series at the point of self-consistency determined from the leading term in this series. Away from self-consistency the sum of the correction terms becomes large. Although the first few correction terms appear to represent surface energies, their sum gives a volume energy. The usual method of defining an infinite medium corresponds to a limiting process which throws away the dominant correction terms except possibly at the point of self-consistency. The limiting process elsewhere violates the conditions under which the formal series for the energy corresponds to an eigenvalue of the Schrödinger equation.

530.145

2081. FORMULATION OF FIELD THEORIES OF COMPOSITE PARTICLES. K.Nishijima.
Phys. Rev., Vol. 111, No. 3, 995-1011 (Aug. 1, 1958).

Based upon Feynman's over-all space—time point of view, a general method for dealing with bound-state problems is presented, with emphasis on the properties of Green's functions that should be satisfied in the field theories with bound states. The Chew—Low or Lehmann—Symanzik—Zimmermann equations are generalized so as to include composite particles. The possibility is examined of distinguishing between elementary and composite particles. An investigation is made of how the S matrix elements for processes involving composite particles are related to those involving no composite particles. This problem is illustrated by the relation between $p + p \rightarrow n + p + \pi^+$ and $p + p \rightarrow d + \pi^+$.

530.145

2082. FOURTH-ORDER NUCLEON—NUCLEON DISPERSION RELATIONS. M.T.Grisaru.
Phys. Rev., Vol. 111, No. 6, 1719-26 (Sept. 15, 1958).

The fourth-order contribution to the nucleon—nucleon scattering amplitude is shown to satisfy the conditions necessary for writing dispersion relations. The imaginary part is explicitly calculated and shown to agree with the absorptive part obtained from general principles.

530.145

2083. ON THE STATIONARY SCATTERING THEORY WITH BOUND STATES. W.Brenig.
Z. Naturforsch., Vol. 13a, No. 5, 359-63 (May, 1958). In German.

The matrix elements with states belonging to a continuous energy spectrum ϵ are in general singular functions of ϵ, but in the presence of bound states these singularities are often not explicit. In simple examples it is shown what mistakes one is liable to make due to the existence of such hidden singularities, and what precautions one has to take in order to avoid them. P.Roman

530.145 : 530.162 : 533.7

2084. CONTRIBUTION TO THE THEORY OF THE FERMI LIQUID. L.D.Landau.
Zh. eksper. teor. Fiz., Vol. 35, No. 1(7), 97-103 (1958). In Russian.

The scattering properties for angle 0° of quasi-particles colliding in a Fermi liquid are considered. It is shown that the amplitude of this scattering depends significantly on the limit to which the ratio of the transfer of momentum and energy during the collision approaches as these quantities tend to zero. It is ascertained which of these limits is connected with the energy of the quasi-particles involved in the general theory of the Fermi liquid previously developed by the author.

530.145

2085. SPECTRAL REPRESENTATION OF THE TWO-MESON GREEN'S FUNCTION. V.N.Gribov.
Zh. eksper. teor. Fiz., Vol. 35, No. 2(8), 416-27 (1958). In Russian.

A spectral representation of the two-meson Green's function was obtained which is similar to that derived recently by Schwinger, Nomby and Gribov (1957-8) for the vertex part. The analytic properties of the function are examined. It follows from these representations that dispersion relations for the scattering amplitude exist for a given scattering angle in the c.m.s. These relations are obtained and discussed.

530.145

2086. ON THE DISPERSION RELATIONS IN NON-RELATIVISTIC SCATTERING THEORY. L.D.Faddeev.

Zh. eksper. teor. Fiz., Vol. 35, No. 2(8), 433-9 (1958). In Russian.

It is proposed that the dispersion equations for the scattering amplitude on a potential be deduced by studying the Green's function of the total Hamiltonian. The method is illustrated for the case of a three dimensional non-relativistic equation for scattering on a fixed centre, the relations previously obtained by Wong and Huri being strictly obtained in this manner. The existence of the dispersion relations is related to the problem concerning the complete characteristic for the S-matrix for various equations for scattering on a potential.

530.145

2087. GENERALIZED EQUATIONS WITH A SELF-CONSISTENT FIELD. P.S.Zyryanov.

Zh. eksper. teor. Fiz., Vol. 35, No. 2(8), 448-51 (1958). In Russian.

The Hartree equations extended to the case of non-stationary states are modified so as to include short-range scattering of particles as a sort of momentum interaction. The connection between these equations and the theories of Landau and Silin is demonstrated. On basis of the generalized equations, dispersion relations for Fermi and Bose systems of interacting particles are derived.

530.145

2088. ON SCATTERING OF "CLOTHED" PARTICLES IN QUANTUM FIELD THEORY. Yu.V.Novozhilov.

Zh. eksper. teor. Fiz., Vol. 35, No. 3(9), 742-9 (1958). In Russian.

A scattering theory is considered in which the virtual "clouds" around the particles are always taken into account exactly. The theory is based on the representation of basic functionals in the form of products of single particle functionals. In the absence of vacuum polarization the equations for the matrix elements are automatically renormalized and the matrix elements can be expressed in terms of the single-nucleon matrix elements.

530.145

2089. RELATIVISTIC THEORY OF POLARIZATION EFFECTS. Yu.M.Shirokov.

Zh. eksper. teor. Fiz., Vol. 35, No. 4(10), 1005-12 (1958). In Russian.

A relation was obtained which connects the product of the wave-functions of two free relativistic particles of given mass and spin with the wave-function describing the free motion of the system as a whole. The relation is an analogue of the Clebsch—Gordan relation for summation of angular momenta. Formluae for relativistic polarization and correlation effects can be derived with the aid of this relation. Lorentz transformations for arbitrary tensor moments were obtained.

530.145

2090. OSCILLATIONS OF A DEGENERATIVE ELECTRON FLUID. V.P.Silin.

Zh. eksper. teor. Fiz., Vol. 35, No. 5(11), 1243-50 (1958). In Russian.

Oscillations of an electron fluid are considered on basis of Landau's theory of Fermi fluids. The oscillations reduce to longitudinal plasma waves, transverse electromagnetic waves, zero sound and spin waves.

530.145 : 539.12

NUCLEON SPECTRUM IN STRONG-COUPLING THEORY. See Abstr. 1656

530.145 : 539.12

2091. THE EFFECT OF A SCALAR MESON INTERACTION BETWEEN MUONS AND BARYONS. I.R.Gatland.

Nuclear Phys., Vol. 9, No. 2, 267-72 (Dec. [1], 1958)

The effect of a scalar meson interaction (as well as the usual photon interaction) in muon—nucleon scattering is evaluated in second-order perturbation theory and is compared with the known properties of the muon. The existence of the new interaction is found to be compatible with the experimental results on the muon range and scattering and the nuclear photoproduction of muon pairs if the meson mass is approximately three nucleon masses and the meson has medium strong interactions with baryons and muons.

530.145 : 530.162

EXTENSION OF THE HARTREE METHOD TO STRONGLY INTERACTING SYSTEMS. See Abstr. 1100

530.145

2092. ON THE SOMMERFELD CONDITIONS AND WAVE MECHANICS. A.Datzeff.

C.R. Acad. Sci. (Paris), Vol. 247, No. 19, 1565-8 (Nov. 10, 1958). In French.

In the passage from wave mechanics to classical mechanics in the limit $h \to 0$ the Schrödinger equation leads to that of Hamilton-Jacobi, although the formal expression for the wave-function become invalid. When the motion is periodic, validity may be preserved by imposing on the action integral the Sommerfeld quantum conditions as required by considerations of uniformity of the wave-function. In the case of the harmonic oscillator, it is shown that one obtains probability amplitudes which in the limit reduce to the classical values both inside and outside the classically permitted region.

T.R.Carson

530.145

2093. ON THE INVERSION PROBLEM FOR A KLEIN—GORDON WAVE EQUATION. V.De Alfaro.

Nuovo Cimento, Vol. 10, No. 4, 675-81 (Nov. 16, 1958).

Deals with the problem of obtaining the static potential which corresponds to given resonance parameters in the case of a Klein—Gordon wave-equation. The results are an extension of those alread found in the non-relativistic case. The class of potentials is restricted to those vanishing outside a finite range a. The knowledge of the resonance parameters allows one to obtain an approximate solution of the so called Gel'fand—Levitan equation which provides the desired potential.

530.145

2094. THE INVERSION PROBLEM IN WAVE MECHANICS AND DISPERSION RELATIONS. M.Verde.

Nuclear Phys., Vol. 9, No. 2, 255-66 (Dec. [1], 1958).

The analytical properties of the eigensolutions of a wave equation as function of the energy, considered as a complex variable, serve to give a new derivation of the so called Gel'fand and Levitan integral equation which determines the interaction when the spectral function is known. This method allows an immediate extension to the Dirac and Klein—Gordon wave equations. It gives a natural generalization of dispersion relations for finite distances.

530.145 : 539.1

2095. VARIATIONAL METHODS AND THE NUCLEAR MANY-BODY PROBLEM. R.Brout.

Phys. Rev., Vol. 111, No. 5, 1324-33 (Sept. 1, 1958).

The general form of the energy of the ground state of a many-fermion system is shown to be exactly of the form proposed by Brueckner and Bethe, without approximation. In a variational treatment, if the trial wave-function is picked containing only pair correlations, together with all possible unlinked pairs, it is described by a two-body excitation matrix $\langle m_1m_2|A|p_1p_2\rangle$. Variation of this mat in the Ritz—Rayleigh principle yields a set of integral equations of the scattering type for the matrix A. Hole-state energies are given self-consistently in terms of the matrix A, but particle-state energies are Hartree—Fock energies. This may be corrected for by widely enlarging the class of terms admitted into the wave-function If the approximation is then made of omitting a class of terms, defined as cross-linked clusters in $\langle\psi|H|\psi\rangle$, the particle-state energies are easily renormalized. Variation then leads to an infinite hierarchy of integral equations.

530.14

2096. DIRAC-LIKE WAVE EQUATIONS FOR PARTICLES OF ZERO REST MASS, AND THEIR QUANTIZATION. J.S.Lomont.

Phys. Rev., Vol. 111, No. 6, 1710-16 (Sept. 15, 1958).

The basic algebraic structure of the Maxwell equations (in a particular form) is first abstracted. This structure is then used a a model for wave-equations for other massless particles, Gauge-independent wave equations of Dirac type (more precisely, of Pauli type) are thus found for every half-integral positive spin. Multiple spin equations of the Dirac type are also found. The single-spin equations are then quantized. The infinite-dimensional equations a not considered.

530.145 : 538.5

2097. THE WAVE MECHANICAL DAMPED HARMONIC OSCILLATOR. K.W.H.Stevens.

Proc. Phys. Soc., Vol. 72, Pt 6, 1027-36 (Dec., 1958).

The classical problem of a damped harmonic motion is formulated wave mechanically, with particular reference to the charge in a tuned circuit, and the electromagnetic field in a resonant cavity. Results in close agreement with the classical problem are obtaine without using perturbation theory. The classical frequency appear in the time dependence of the eigenfunctions and the classical damping appears as a decay in the eigenvalues. Zero point energy and thermal noise are discussed. The formulation is expected to break down, at very high frequencies, for tuned circuits and it is suggested that the same may be true for cavity oscillations and travelling electromagnetic waves.

530.145

2098. ON THE ASYMPTOTIC STATES OF ORIENTATED PARTICLES. Yu.V.Novozhilov.
Vestnik Leningrad. Univ., (1958), No. 16, Ser. Fiz. Khim., No. 3, 21-3. In Russian.

Starting from an exact Hamiltonian it is shown that, by suitable symmetrization and anti-symmetrization, equations for asymptotic particle operators in quantum field theory can be obtained.

C.R.S.Manders

530.145

2099. REMARKS ON A PAPER BY H. HARMUTH ABOUT THE UNCERTAINTY RELATION AND THE SCHRÖDINGER EQUATION. L.Biermann, K.Jörgens and A.Schlüter.
Z. Naturforsch., Vol. 11a, No. 9, 766-7 (1956). In German.

An attempt to consider Heisenberg's uncertainty relation as a condition for the convergence of the solution of a difference equation to the solution of the approximated time-dependent Schrödinger differential equation (Harmuth, Abstr. 5700/1956) is criticized.

W.A.Hepner

530.145

2100. ON THE QUANTUM THEORY OF NON-LINEAR WAVE EQUATIONS. IV. R.Ascoli and W.Heisenberg.
Z. Naturforsch., Vol. 12a, No. 3, 177-87 (1957). In German.

For Pt III, see Abstr. 7705 (1955). Continuing the investigation of Heisenberg's non-linear spinor equation, with scalar self-interaction, the long-range forces are analysed, and it is found that the theory contains the whole of electrodynamics. A rough approximation leads to about half the actual value of the fine-structure constant. Furthermore the introduction of the isotopic spin is discussed, and this leads to arguments for the non-conservation of parity in weak decays. The role of the leptons in this scheme is not yet clear.

W.A.Hepner

530.145

2101. QUANTUM MECHANICAL PROBABILITIES AS SUMS OVER TRAJECTORIES. G.V.Ryazanov.
Zh. eksper. teor. Fiz., Vol. 35, No. 1(7), 121-31 (1958). In Russian.

A new formulation of non-relativistic quantum mechanics: a general definition of the probability for any event is proposed. The physical content of quantum mechanics reduces to a single principle which is similar to Gibbs' principle and permits one to solve problems without recourse to wave-functions and operators.

530.145

2102. ON THE WAVE-FUNCTIONS OF MANY-ELECTRON SYSTEMS. V.I.Perel'.
Zh. eksper. teor. Fiz., Vol. 35, No. 3(9), 685-90 (1958). In Russian.

A general form of the wave-function is derived which is the eigenfunction of S^2 and S_z and satisfies the Pauli principle. An expression is given for the Schroedinger wave-function of a system that consists of single-electron functions.

530.145

2103. ON THE PRECISION OF QUANTUM-MECHANICAL MEAN VALUES COMPUTED BY THE VARIATIONAL METHOD. V.M.Buĭmistrov.
Zh. eksper. teor. Fiz., Vol. 35, No. 5(11), 1161-4 (1958). In Russian.

A method for estimating the accuracy of the approximate eigenvalues of a linear self-adjoint operator was proposed in the papers of Kato (J. Phys. Soc. Japan, Vol. 4, 334, 1949) and Temple (Abstr. 2488/1952). It is shown that the precision of evaluation of the quantum-mechanical mean value of a function of the coordinate system can also be estimated.

530.145

2104. ON QUANTUM THEORIES WITH INDEFINITE METRIC. R.Ascoli and E.Minardi.
Nuclear Phys., Vol. 9, No. 2, 242-54 (Dec. [1], 1958).

It is shown that any probabilistically interpretable quantum theory using a Hilbert space of indefinite metric is equivalent to a quantum theory using a Hilbert space of positive definite metric. However, in general a formally local theory is transformed in this way into a theory that is no longer local: the formally local quantities cannot be measured. General criteria are given which permit to decide whether a theory may be probabilistically interpreted or not. When applied to the scattering of two θ on one N particle in the Lee model, these criteria lead to the result that the probabilistic interpretation is possible not only in the case of the dipole ghost, but also in the case of the complex conjugate energy eigenvalues of the interacting V particle. It is also concluded that in both cases, however, the probabilistic interpretation of more complicated scattering problems is only possible provided that new discrete energy eigenstates of negative norm do not appear.

STATISTICAL MECHANICS
TRANSFER PROCESSES

530.16 : 532.7

STATISTICAL MECHANICAL THEORY OF TRANSPORT PROCESSES IN LIQUIDS. See Abstr. 1143

530.162 : 536.48

2105. ON THE COLLECTIVE PROPERTIES OF A BOSON SYSTEM. J.G.Valatin and D.Butler.
Nuovo Cimento, Vol. 10, No. 1, 37-54 (Oct. 1, 1958).

A method in close correspondence with the theory of superconductivity of Bardeen, Cooper and Schrieffer is applied to a boson system, extending an earlier approach by Bogolubov. Minimizing the energy with respect to a trial ground state vector of exponential form, new equations and expressions are derived for the excitation spectrum of bosons. The expressions are in a one to one correspondence with those for fermions, from which formally they differ only through signs. The physical content of the expressions is, however, very different. Equations with a predominantly repulsive interaction which in the fermion case have no collective solutions, lead to such solutions for bosons because of a partial Bose–Einstein condensation. It is pointed out that the method is related to a linearization of the quantized matter field equations. Temperature dependent equations are obtained by the same methods as in the theory of superconductivity. The λ-point is defined by the disappearance of the partial Bose–Einstein condensation.

530.162

2106. THE EIGENVALUES OF A RANDOMLY DISTRIBUTED MATRIX. R.Englman.
Nuovo Cimento, Vol. 10, No. 4, 615-21 (Nov. 16, 1958).

The elements of a symmetric matrix are supposed to be independent random variables, with a distribution law that depends on the distance of the element from the diagonal. What is the distribution of the eigenvalues of this matrix, in the limit as its size becomes infinite? A method, based on the resolution of the symmetric matrix into two triangular ones, is developed, which reduces the problem to a form which has the promise of being soluble by numerical methods.

530.162 : 539.2

2107. CORRELATION ENERGY OF A FREE ELECTRON GAS. P.Nozières and D.Pines.
Phys. Rev., Vol. 111, No. 2, 442-54 (July 15, 1958).

The limits of validity of the correlation-energy calculations in the regions of high density, low density, and actual metallic electron densities are discussed. Simple physical arguments are given which show that the high-density calculation of Gell-Mann and Brueckner is valid for $r_s <\sim 1$ while the low-density calculation of Wigner is valid for $r_s >\sim 20$. For actual metallic densities it is shown that the contribution to the correlation energy from long-wavelength momentum transfers ($k < \beta k_0 < 0.47 r_s^{1/2} k_0$) may be accurately calculated in the random phase approximation. This contribution is calculated using the Bohm–Pines extended Hamiltonian, and is shown to be

$$E(\beta) = \left(-0.458\frac{\beta^2}{r_s} + 0.866\frac{\beta^3}{r_s^{3/2}} - 0.98\frac{\beta^4}{r_s^2} + \right.$$

$$\left. + 0.019\frac{\beta^4}{r_s} + 0.706\frac{\beta^5}{r_s^{5/2}} + \ldots\right)\text{ry}.$$

An identical result is obtained by a suitable expansion of the result of Gell-Mann and Brueckner; the validity of the Bohm–Pines neglect of subsidiary conditions in the calculation of the ground-state energy is thereby explicitly established. The contribution to the correlation energy from sufficiently high momentum transfers ($k >\sim k_0$) will arise only from the interaction between electrons of antiparallel spin, and may be estimated using second-order perturbation theory. The contribution arising from intermediate momentum transfers ($0.47 r_s^{1/2} k_0 <\sim k <\sim k_0$) cannot be calculated analytically; the interpolation procedures for this domain proposed by Pines and Hubbard are shown to be nearly identical, and their accuracy is estimated as ~15%. The result for the over-all correlation energy using the interpolation procedure of Pines is

$$E_C \cong (-0.115 + 0.031 \ln r_s) \text{ ry.}$$

530.162

2108. TIME-CORRELATION FUNCTIONS IN THE STATISTICAL MECHANICS OF TRANSPORT PROCESSES. H.Mori.

Phys. Rev., Vol. 111, No. 3, 694-706 (Aug. 1, 1958).

A kinetic equation governing the time dependence of the correlation function of flux is established for dilute gases and is integrated to yield a relation between the correlation time and the transport cross-section. The spectrum of the binary collision operator is determined for spherically symmetric forces between molecules, which, for the hard-core model, consists of two discrete values in the classical limit; hence it is shown that the question of validity of approximating the correlation function by an exponential decay depends upon the type of intermolecular force and the temperature of the system. Approximate eigenvalues of the master collision operator are obtained corresponding to the fluxes of viscosity and thermal conduction, and their relations to the macroscopic transport coefficients are derived. These relations lead to a new approach to the transport properties of dilute gases, which is different from Enskog–Chapman's method, but yields the same results in the classical limit. An expansion formula for the canonical transformation describing the motion of dilute gases is obtained and is employed to clarify the assumption of random a priori phases in the momentum representation for spatially uniform gases; this is done by formulating the quantum-mechanical equivalent of Brout's idea in the classical derivation of the master equation.

530.162

2109. QUANTUM STATISTICAL THEORY OF ELECTRON CORRELATION. R.D.Cowan and J.G.Kirkwood.

Phys. Rev., Vol. 111, No. 6, 1460-6 (Sept. 15, 1958).

The average electrostatic potential distribution about a given electron is calculated for a system of point-charge electrons embedded in a neutralizing continuum of positive charge. The calculation is classical, involving a Poisson equation of the Debye–Hückel type, except that the electron density is treated by means of Fermi–Dirac statistics as in the Thomas–Fermi theory of the atom. The calculated energy due to electrostatic interactions agrees with the quantum-mechanical exchange plus correlation energy over the observed range of metal valence-electron densities, $2 \leq r_s \leq 6$, but is too small at larger and smaller densities. (r_s is the electron-sphere radius in units of the Bohr radius). The equilibrium density ($T = p = 0$) occurs at $r_s = 4.3$, at which point the compressibility is 69 per megabar. The electronic specific heat is linear in T at low temperatures and varies from 0.9 to 0.74 of the Sommerfeld value over the observed metal density range.

530.162

2110. STATISTICAL MECHANICS OF COUPLED BOSONS IN THE HEISENBERG REPRESENTATION. R.H.Kraichnan.

Phys. Rev., Vol. 112, No. 4, 1054-5 (Nov. 15, 1958).

A system of bosons interacting by 2-body forces is treated in momentum space in the Heisenberg representation, assuming a statistically homogeneous and stationary state. The principle of weak statistical dependence of different momentum modes, previously applied to turbulence dynamics, is used to obtain an exact expansion expressing quadrilinear (2-body) time-displaced correlation functions of the second-quantized field variables in terms of bilinear time-displaced correlation functions and average impulse-response functions. The last-named functions are defined in terms of the exact Green's operator, for infinitesimal sources, of the nonlinear Heisenberg equations of motion. A set of coupled integral equations are then obtained which determine both the bilinear correlation functions and the response functions. By retaining in these equations only the lowest terms in the cited expansion, a theory is obtained which includes particle "self-energy" interactions with the medium of all orders. A modification of the theory is briefly outlined which includes, at finite temperatures, all the processes described at absolute zero by the Brueckner approximation and, in addition, 3-body effects iterated to all orders, which are omitted in that approximation.

530.162

2111. A GENERALIZED VARIATIONAL METHOD FOR THE TREATMENT OF TRANSPORT PROCESSES IN METALS AND SEMICONDUCTORS. D.Dorn.

Z. Naturforsch., Vol. 12a, No. 9, 739-49 (1957). In German.

Ideas of entropy increase are developed and applied to transport problems, of which electrical and thermal conductivities form good examples. C.A.Hogarth

530.162

2112. ON THE STATISTICALLY STATIONARY STATES OF MECHANICAL SYSTEMS. R.Kurth.

Z. Naturforsch., Vol. 13a, No. 1, 28-30 (Jan., 1958). In German.

For mechanical systems, and especially for cosmical mechanical systems, the existence of statistically stationary states is not immediately evident. It is assured if the potential function of the system has a true relative minimum. This is the case, for example, for interstellar gas, but not for star systems. N.L.Johnson

530.162

2113. THE ERGODIC PROBLEM IN CLASSICAL STATISTICAL MECHANICS. R.Kurth.

Z. Naturforsch., Vol. 13a, No. 2, 110-13 (Feb., 1958). In German.

It is shown that, if the number of degrees of freedom is sufficiently large and the temperature sufficiently high, the time and phase averages occurring in practice are "in general almost equal". W.A.Hepner

530.19

2114. THE PROBABILISTIC METHOD FOR RADIATIVE TRANSFER PROBLEMS. DIFFUSE REFLECTION AND TRANSMISSION IN A FINITE ATMOSPHERE. S.Ueno.

C.R. Acad. Sci. (Paris), Vol. 247, No. 18, 1443-5 (Nov. 3, 1958). In French.

See Abstr. 4771 (1958).

530.19

2115. ON THE RATE OF CONVERGENCE OF THE SPHERICAL-HARMONICS METHOD IN THE MILNE PROBLEM. B.Davison.

Canad. J. Phys., Vol. 36, No. 10, 1323-35 (Oct., 1958).

The extrapolated end point, z_0, and the ratio of current to flux at the free surface, $j(0)/\rho(0)$, for the Milne problem are evaluated by the spherical-harmonics method in the P_N approximation, N being odd. It is shown that, for N large, the approximations to these quantities are related to the exact values by

$$\text{(A)} \qquad z_{0,N} = z_0 - \pi^2 c/48N^2 + O\{(c^2+1)/N^3\} + O[N(\zeta_1/\zeta_2)^N f_1(c)],$$

$$\text{(B)} \qquad [\psi_1(0)/\psi_0(0)]_N = [j(0)/\rho(0)]\{1 + O[(\zeta_1/\zeta_2)^N f_3(c)]\},$$

in which c is the number of secondaries per collision, $f_1(c)$ and $f_3(c)$ are independent of N, and ζ_1 and ζ_2 are the absolutely lesser and greater roots of

$$\zeta^2 - 2\zeta + \kappa^2 = 0,$$

κ being the exact inverse diffusion length. The relation (A) is subject to the restrictions

$$N \gg c \quad \text{if } c > 1,$$
$$N(|\zeta_1/\zeta_2|)^N \ll 1 \quad \text{if } c < 1.$$

GENERAL MECHANICS

MECHANICS OF SOLIDS

531.55

2116. GENERAL FORMULATION OF POWERED FLIGHT TRAJECTORY OPTIMIZATION PROBLEMS. B.D.Fried.

J. appl. Phys., Vol. 29, No. 8, 1203-9 (Aug., 1958).

A general formalism, applicable to a wide class of missile trajectory optimization problems, is obtained by straightfoward application of standard methods of the calculus of variations. In all cases, a point particle model is used for the missile. It is shown that the steering and burning programmes are determined always by the same differential equations, different optimization problems corresponding simply to different boundary conditions. Results found previously by assuming the gravitational force field uniform during powered flight are obtained as special cases and the corrections to these due to variations in the force field are discussed. The extensions to variable mass and thrust programmes, variable burning times, etc. are also included.

MECHANICAL MEASUREMENTS

531.715 : 535.417

ERRORS IN THE MEASUREMENT OF FILM THICKNESS BY MULTIPLE-BEAM INTERFEROMETRY. See Abstr. 1335

531.715 : 535.417

APPLICATIONS OF THE INTERFEROMETER USING CORRELATED RAYS. See Abstr. 1336

531.717.3 : 535.417

OPTICAL APPARATUS FOR DEPTH SENSING. See Abstr. 1337

531.787 : 539.893

HIGH-PRESSURE MANOSTAT AND PRESSURE TRANSDUCER. See Abstr. 1916

MECHANICS OF FLUIDS

532.12

2117. ON THE STRUCTURAL PART OF THE COMPRESSIBILITY OF LIQUIDS. V.S.Venkatasubramanian.
J. Indian Inst. Sci. A, Vol. 40, No. 3, 132-9 (July, 1958).

The "structural" part of the bulk modulus, represented by the contribution of the entropy term in the free energy, is examined and related to the temperature coefficient of the bulk modulus. This quantity is computed for the harmonic oscillator and free volume models, as also on the basis of a simple kinetic theory treatment. The values agree with experiment as regards the order of magnitude.

532.133

2118. FREE VOLUME APPROACH TO POLYSTYRENE MELT VISCOSITY. M.L.Williams.
J. appl. Phys., Vol. 29, No. 10, 1395-8 (Oct., 1958).

The Doolittle (Abstr. 3335, 1952) approach to Newtonian viscosity assumes $\eta = A \exp B/f$, where A and B are constants independent of temperature and f, the relative free volume, is $(v - v_0)/v_0$. Here v is the specific volume and v_0 is the occupied volume. Using machine computations, this equation was applied to published data on polystyrene, replacing v by its equivalent $v_g + (dv/dT)(T - T_g)$, where v_g is the specific volume at the glass temperature T_g. The agreement between calculated and observed viscosities is at least as good, and perhaps better, than that afforded by other existing empirical expressions. The constant B is independent of molecular weight and temperature while v_0 depends slightly on molecular weight. A log—log plot of A against molecular weight M produces two straight lines intersecting at M = 35 000. At higher values of M, the slope is 3.4; at lower values, it is slightly greater than one. This treatment separates the melt viscosity of polystyrene into two factors, A, dependent only on structural parameters, and f, which is determined by the specific volume and is a function of temperature.

532.133

2119. CRITICAL CONCENTRATION EFFECTS IN DILUTE SOLUTION VISCOSITIES OF POLYMERS. S.Gundiah and S.L.Kapur.
J. sci. industr. Res., Vol. 17B, No. 8, 330-1 (Aug., 1958).

The authors report on a departure from linearity of the $\eta_{sp.}/C$ versus C curves for dilute solutions of polystyrene in benzene and in methyl ethyl ketone. They have found similar critical concentrations by direct estimation from the $\eta_{sp.}/C$ versus C plots and when working with ternary systems of the type "polymer A-polymer B-solvent S". R.Schnurmann

532.133

2120. VISCOSITY OF NORMAL PARAFFINS.
Y.P.Varshni and S.N.Srivastava.
Proc. Phys. Soc., Vol. 73, Pt 2, 153-9 (Feb., 1959).

It is shown that the Andrade—Guzman relation $\eta = Ae^{b/T}$ for the variation of viscosity with temperature is adequate for normal paraffins. Andrade's improved equation $\eta v^{1/3} = Be^{c/vT}$ gives less satisfactory results.

532.137

2121. VISCOSITY MEASUREMENTS AT HIGH PRESSURES.
L.Heyne.
Exper. Tech. der Phys., Vol. 5, No. 6, 261-70 (1957). In German.

A pressurized rolling-sphere viscometer for the range between 10 and 50 000 cP is described The instrument does not require tilting because a tuned circuit is used to indicate the movement of the sphere over a path whose length is defined by the position of two induction coils. The viscosities of 5 and 10% polystyrene solutions in bromobenzene and in toluene were measured at various temperatures. Pure bromobenzene at 25°C was found to solidify at 3200 atm, whereas solidification was not reached for a 10% polystyrene solution at this temperature. A 5% solution, on the other hand, showed a sharp increase in viscosity just below 6000 atm. R.Schnurmann

532.137

2122. VISCOSITY DETERMINATION BY THE OSCILLATING VESSEL METHOD. I. THEORETICAL CONSIDERATIONS.
R.Roscoe.
Proc. Phys. Soc., Vol. 72, Pt 4, 576-84 (Oct., 1958).

When a liquid is placed in a vessel held by a torsional suspension and the whole is set in rotation about a vertical axis, the viscosity of the liquid may be deduced from observations of the time period and decrement of the oscillations. This method of measuring viscosity has many practical advantages, but there are mathematical difficulties in making the calculations. The cases of spherical and cylindrical vessels are considered in detail and formulae are obtained for the calculation of the viscosity which are very accurate and easier to use than those previously proposed. The case of an axially symmetrical vessel which departs slightly from the spherical form is also considered, and formulae (valid only when the frequency of oscillation is high) are obtained for an axially symmetrical vessel of any shape. Corrections for the effect of external air resistance are also discussed.

532.137

2123. VISCOSITY DETERMINATION BY THE OSCILLATING VESSEL METHOD. II. THE VISCOSITY OF WATER AT 20°C.
R.Roscoe and W.Bainbridge.
Proc. Phys. Soc., Vol. 72, Pt 4, 585-95 (Oct., 1958).

The practical possibilities of the oscillating vessel method for accurate absolute measurements were investigated. An improvement in Andrade and Chiong's apparatus was effected by using a capillary tube for the stem of the spherical bulb so that the liquid acted as its own thermometer. Abnormally large logarithmic decrements were found to occur with large amplitudes of rotation, and attention has been given to the best statistical method of calculating the decrement while avoiding this effect. A value of 1.0025 ± 0.0005 cP was obtained for the viscosity of water at 20°C, but an analysis of the sources of error indicates that the accuracy could be increased by further improvements well beyond that of the best capillary-tube determination (1.0019 ± 0.0003 cP). These improvements would include the replacement of the spherical bulb by a cylindrical vessel.

532.5

2124. ON THE NOTION OF SPIN IN RELATIVISTIC HYDRODYNAMICS OF FLUID MASSES IN ROTATION. M.Kléman.
C.R. Acad. Sci. (Paris), Vol. 247, No. 21, 1831-3 (Nov. 24, 1958). In French.

A definition of spin or internal kinetic moment in relativistic hydrodynamics is proposed and it is shown to possess all the properties associated with spin in quantum theory. A relation which resembles the equiprojectivity theorem for velocities in classical (rigid) mechanics is also derived. T.R.Carson

532.5

2125. ON SOME ISOTROPIC SOLUTIONS FOR THE CASE OF FLUID SPHERE IN RELATIVITY. R.V.Wagh.
J. Univ. Bombay, Vol. 26, Pt 5, 16-19 (March, 1958).

532.517

2126. FRICTION FACTORS FOR AXIAL NON-NEWTONIAN ANNULAR FLOW. A.G.Fredrickson and R.B.Bird; W.R.Wilcox.
Industr. engng. Chem., Vol. 50, No. 10, 1599-1600, 1600 (Oct., 1958).

532.517.4 : 551.51 : 538.566.2

2127. SPACE—TIME CORRELATIONS IN STATIONARY ISOTROPIC TURBULENCE. G.Münch and A.D.Wheelon.
Phys. of Fluids, Vol. 1, No. 6, 462-8 (Nov.-Dec., 1958).

The correlation between Fourier velocity components at the same wave number k and two instants separated by a time τ is investigated for a homogeneous, isotropic, and stationary turbulent field. Ensemble averages of four velocity components are related to second-order averages as in a normal distribution. A power series in τ for the time-displaced kinetic energy spectrum $E(k, \tau)$ is derived and the coefficient of τ^2 evaluated explicitly using the Heisenberg spectrum for $\tau = 0$. The asymptotic behaviour of this term for an infinite Reynolds number R shows that the relaxation time associated with eddies of wave number k varies as k^{-1}. These results were verified by numerical integrations for finite large R. The resulting discrepancy with the dimensional result $\tau_k \alpha k^{-2/3}$ is ascribed to the nonuniversality of the method of analysis followed. A general integrodifferential equation for $E(k, \tau)$ is then derived and shown to admit solutions in similarity variables of the form $\xi = k\,\tau^{1/\beta}$. The case $\beta = 2/3$ corresponds to the Kolmogoroff spectral law. Recent objections to the quasi-normal approximation are criticized briefly in an appendix.

532.517.4

2128. THE DECAY IN TIME OF THE ENERGY SPECTRUM IN HOMOGENEOUS, ISOTROPIC TURBULENCE REGARDED AS AN INITIAL VALUE PROBLEM. K.Meetz.

Z. Naturforsch., Vol. 11a, No. 10, 832-47 (1956). In German.

The Heisenberg theory of the decay of homogeneous turbulence leads to an integro-differential equation for the spectral energy density $F(k,t)$ involving an undetermined dimensionless parameter κ. The parabolic initial value problem is here integrated numerically for $\kappa = 0$, 0.47, 0.75, 1.40. The initial distribution $F(k,t_0)$ is obtained from the experiments of Stewart and Townsend. The decay of the total energy allows an estimate to be made of κ with the help of the Batchelor–Townsend measurements, and it is found that $\kappa = 0.75$ is the best value. (Proudman has earlier found that $\kappa = 0.45$). The detailed results are compared with those given by a simplified "similarity" theory in which it is assumed that the distribution is "scaled" by a function of time only. The latter approximate theory gives a good representation of the final approach towards equilibrium.

R.O.Davies

532.517.4

2129. THE DECAY IN TIME OF THE VELOCITY AND PRESSURE CORRELATION FUNCTIONS IN HOMOGENEOUS, ISOTROPIC TURBULENCE REGARDED AS AN INITIAL VALUE PROBLEM. K.Meetz.

Z. Naturforsch., Vol. 11a, No. 10, 848-57 (1956). In German.

Fixing the magnitude of κ in Heisenberg's theory of the decay of isotropic turbulence (see preceding abstract) allows a calculation, of the decay in time, not only of the total energy but also of the distribution in energy and hence of the two point correlation functions for velocity and pressure. The velocity results are compared directly with the experiments of Townsend and Stewart and show that the best value of κ is 0.47. This is to be contrasted with the value 0.75 which is indicated by the results on energy decay, the discrepancy reflecting perhaps the inadequacy of the Heisenberg model. The value of 0.47 is on the whole more acceptable because it does less violence to the energy measurements than a higher value would do to the velocity measurements. Calculations are made of the correlations in pressure but there is no experimental material with which to test them.

R.O.Davies

532.542

2130. FLOW FORMATION WITH SUCTION OR INJECTION. R.S.Nanda.

J. Phys. Soc. Japan, Vol. 13, No. 7, 748-53 (July, 1958).

The problem of boundary layer control with suction or injection is discussed for: (1) flow formation between two planes at a finite distance apart; (2) flow formation in the annular space between two concentric circular cylinders. Exact solutions of the full Navier–Stokes equations are obtained in both the cases. Results obtained by Hashimoto for an infinite flat plate are deduced as a special case.

532.581

2131. NOTE ON THE FORCES ON AN ELLIPTIC CYLINDER MOVING IN A VISCOUS LIQUID AT SMALL REYNOLDS NUMBERS. Y.Takaisi.

J. Phys. Soc. Japan, Vol. 13, No. 8, 954-9 (Aug., 1958).

The steady flow of a viscous liquid past an elliptic cylinder at an arbitrary angle of attack is discussed on the basis of a Reynolds' number expansion using a conformal transformation of the general solutions of Oseen's equation, which are expressed in integral forms. Thus the expansion formulae for the lift and drag coefficients are obtained to the second approximation, and are in perfect agreement with the results obtained recently by Hasimoto and also by Imai. The procedure gives not only a practical method of solving Oseen's equation for the two-dimensional slow steady flow of an unbounded viscous liquid past an arbitrary cylindrical body, but also an effective method of studying the wall-effect upon a cylinder of arbitrary shape moving in a viscous liquid bounded either by a plane wall or by parallel plane walls, provided the mapping function is known for the cylinder.

532.61 : 536.79

THERMODYNAMIC RELATIONS INVOLVING SURFACE TENSION PHENOMENA. See Abstr. 1397

532.612.4

2132. MEASUREMENT OF DYNAMIC SURFACE TENSIONS OF AQUEOUS SOLUTIONS BY THE OSCILLATING JET METHOD. R.Defay and J.R.Hommelen.

J. Colloid Sci., Vol. 13, No. 6, 553-64 (Dec., 1958).

The rate of surface tension lowering of aqueous solutions of ten long-chain alcohols and two dicarboxylic acids was measured by the oscillating jet method. The surface tensions were calculated by the Bohr formula. Seven orifices, standardized with water, were used to determine the variation of surface tensions with age for an aqueous solution of heptanol (0.4 g/1). The results obtained, which lie on a single curve, are compared with published values.

MOLECULAR THEORY OF LIQUIDS

532.7

2133. QUANTUM MECHANICAL EFFECTS ON THE SURFACE TENSION OF SIMPLE LIQUIDS. I.Oppenheim.

Nuovo Cimento Suppl., Vol. 9, No. 1, 180 (1958).

The differences in the surface tensions of the various isotopic species of a given simple substance are calculated. The surface tension is expressed in terms of the quantum mechanical pair distribution function and an expansion of the distribution function in powers of h^2 is utilized. Calculations are made assuming a Lennard–Jones potential of interaction and the validity of the superposition approximation. An approximate theory of corresponding states is used to relate the surface tensions of the isotopes at different temperatures.

532.7

2134. INTEGRAL EQUATION METHOD IN THE THEORY OF LIQUIDS. L.Sarolea.

Nuovo Cimento Suppl. Vol. 9, No. 1, 189-91 (1958).

A general integral relation has been obtained between n-molecule distribution functions which can be specialized to both the Kirkwood and the Yvon–Born–Green integral equations. In the general form it involves 12 terms and cannot be handled rigorously. If, however, the first term only is taken one obtains

$$\rho\gamma(t) = z\varphi(t)/(1-z\varphi(t)),$$

where $\gamma(t)$ is the Fourier transform of $(g(r)-1)$ — $g(r)$ being the pair correlation function, ρ the density, z the activity, and $\varphi(t)$ the limit of $\gamma(t)$ for infinite density. This result yields two phase transitions which are, however, located far from those found experimentally.

R.O.Davies

532.7 : 533.7

2135. NOTE ON THE CORRELATIONS IN A QUANTUM FLUID IN EQUILIBRIUM. J.Yvon.

Nuovo Cimento Suppl., Vol. 9, No. 1, 237-9 (1958). In French.

Short comment on Abstr. 2850/1958. H.London

532.72

2136. THE DIFFUSION OF ARGON AND TRITIUM IN LIQUID NITROGEN. G.Cini-Castagnoli, G.Pizzella and F.P.Ricci.

Nuovo Cimento, Vol. 10, No. 2, 300-9 (Oct. 16, 1958).

The diffusion coefficients of A and HT in liquid N_2 were measured by using the capillary method, at low concentrations, at constant pressure (about 70 cm Hg), within a range of temperature from 67 to 76°K. The results can be expressed by the following equations

$$D(A\text{-}N_2) = 730 \exp\left[-260/T\right] \times 10^{-6}\ \text{cm}^2/\text{sec},$$

$$D(HT\text{-}N_2) = 1\,260 \exp\left[-260/T\right] \times 10^{-6}\ \text{cm}^2/\text{sec}.$$

These results are discussed in terms of the dependence of the diffusion coefficient upon the molecular parameters of the different substances.

532.77 : 532.122

137. ON THE COMPRESSIBILITY OF LIQUID MIXTURES IN RELATION TO CONFORMAL SOLUTION THEORY.
V.S.Venkatasubramanian.
J. chem. Phys., Vol. 29, No. 4, 971-2 (Oct., 1958).

The deviation parameter d$_{12}$ appearing in conformal solution theory has been estimated by earlier workers from the heat of mixing and the volume change of mixing. It is shown here to be proportional also to the excess compressibility of the solution and this fact is used to provide a fresh estimate of d$_{12}$ for 7 solutions, [the sources of the compressibility data are not specified]. The values found are in fair agreement with the earlier values except in acetone—chloroform, where there is a possible effect due to hydrogen bonding. R.O.Davies

532.77 : 541.135.2

138. A THEORETICAL EXPRESSION FOR SOLUBILITY PRODUCT. K.Krishnamurti.
Nature (London), Vol. 182, 1227-8 (Nov. 1, 1958).

The negative logarithm of the solubility product is shown to be a linear function of the quantity ($\alpha_+ z_+^2 + \alpha_- z_-^2$) where α_+ and α_- are the polarizabilities, z_+ and z_- the valencies of the cation and anion respectively. This dependence is found to agree with experiment. W.Good

532.77

139. SOME EQUILIBRIUM AND NON-EQUILIBRIUM PROPERTIES OF AN (n + 1)-STATE IDEAL SOLUTION. R.O.Davies.
Proc. Phys. Soc., Vol. 73, Pt 1, 25-32 (Jan., 1959).

The properties of an assembly of n + 1 reacting isomers in ideal solution is examined with reference to the thermodynamic theory of relaxation. It is shown explicitly how the equilibrium properties of the system can be related to the chemical reaction coefficients and to what extent the formalism of statistical mechanics can be used in this context. The matrix of relaxation times is obtained in terms of the "transition probabilities" together with their derivatives with respect to concentration. The latter terms give rise to a condition (additional to the well-known condition for microscopic reversibility) which must be satisfied if the Onsager reciprocity relations are to be valid. There is no obvious physical interpretation for this extra condition.

532.77

140. CONTRIBUTION TO THE THEORY OF LONGITUDINAL RELAXATION OF PARAMAGNETIC SALT SOLUTIONS.
.A.Al'tshuler and K.A.Valiev.
Zh. eksper. teor. Fiz., Vol. 35, No. 4(10), 947-58 (1958). In Russian.

Paramagnetic longitudinal (spin—lattice) relaxation in solutions of salts of the iron group and rare-earth elements is considered theoretically. The calculations are based on the assumption that, like ionic crystals, liquid solutions contain paramagnetic complexes. The normal vibrations of these complexes are perturbed by the Brownian motion of the surrounding particles; as a result the electric field acting on the paramagnetic ions is changed and relaxation transitions between different stationary states are thus induced. It is shown that when the interval between the two lower Stark sublevels of the ion is ~ 2 kT, two longitudinal relaxation times exist; one of these is due to transitions between various Stark (orbital) levels without spin flip and the other is due to transitions within a Stark level with change of the spin direction. The paramagnetic resonance line width is due to transistions of the first type. The predictions of the theory are in good agreement with the experimental data for copper, chromium and manganese salt solutions.

MECHANICS OF GASES
VACUUM TECHNIQUE

533.12 : 533.6.011 : 535.376

2141. ELECTRON BEAM FLUORESCENCE PROBE FOR MEASURING THE LOCAL GAS DENSITY IN A WIDE FIELD OF OBSERVATION. B.W.Schumacher and E.O.Gadamer.
Canad. J. Phys., Vol. 36, No. 6, 659-71 (June, 1958).

An electron beam was fired across the field of observation of a low density wind tunnel. Along its path gaseous fluorescence was excited and visible light emitted. The total light output per unit length of the electron beam can be assumed to be proportional to the density of the gas if suitable spectral lines are selected. A three-dimensional scan of the field would give the local density for each spot. Visual, photographic and photometric observation is possible. Some photographs are presented along with approximate data for the light output in air. The spatial resolution of the fluorescence probe is also discussed.

533.24

2142. REMARKS ON THE CALCULATION AND FUNCTIONING OF KAPITZA LIQUEFIERS. R.Spoedlin.
J. Rech. Cent. Nat. Rech. Sci., No. 36, 193-215 (Sept., 1956).
In French.

Given certain limitations on the performance of the heat exchangers in a Kapitza-type gas liquefier and the efficiency of the expansion engine, it is required to find the proportion of gas to be passed through the engine, the proportion of gas liquefied and the temperature distribution. The best choice of specified parameters is examined and a graphical method of solution using an enthalpy—temperature diagram is given. The stability of operation of such liquefiers is discussed. F.E.Hoare

533.275 : 551.508.71

2143. A HIGHLY SENSITIVE HAIR HYGROMETER.
F.Asselmeyer and H.Riedel.
Z. angew. Phys., Vol. 10, No. 10, 460-1 (Oct., 1958). In German.

In this instrument a hair 6 cm long is fixed at its extremities and two short hairs are attached near to the centre. These are wrapped around a differential roller, while a second pair of hairs are wrapped around the smaller diameter section of this roller and attached to an adjustable clamp. The roller carries a mirror giving a spot of light on a scale. The two diameters of the roller are 6.0 and 3.5 mm. It is claimed that the instrument is accurate to ±1% relative humidity. If its time constant is expressed as the time taken to reach 70% of the new value of humidity when it is subjected to a change of moisture, then the time constant is from 0.5 to 2 min when the change is to a lower relative humidity, and 16 to 46 sec when the change is to a higher humidity. A.C.Whiffin

533.59

2144. THEORETICAL ANALYSIS OF ULTRAHIGH VACUUM CONDENSERS. W.R.Mickelsen and J.H.Childs.
Rev. sci. Instrum., Vol. 29, No. 10, 871-3 (Oct., 1958).

The analysis considers the condensation of high-velocity molecular beams on condenser surfaces having very low temperatures. The condenser surface area and volume necessary to maintain a given vacuum are derived theoretically from a highly idealized model.

533.59 : 537.533.35

DEMOUNTABLE VACUUM SYSTEM FOR STUDY OF WORK-HARDENING OF METALS. See Abstr. 1523

533.6 : 536.7

2145. CRITERIA FOR THERMODYNAMIC EQUILIBRIUM IN GAS FLOW. M.Rudin.
Phys. of Fluids, Vol. 1, No. 5, 384-92 (Sept.-Oct., 1958).

When gases flow at high velocity, the rates of internal processes may not be fast enough to maintain thermodynamic equilibrium. By defining quasi-equilibrium in flow as the condition in which the temperature, pressure, density, and velocity deviate by less than a fixed, small percentage from what they would be if the flowing gas could actually be in thermodynamic equilibrium, criteria are derived for determining whether quasi-equilibrium is a stable condition in the flow. By use of excitation of molecular vibration as an example, the general properties of criteria curves are discussed and interpreted. A discussion is given of how to use these results to determine definitely whether a flow is or is not in thermodynamic equilibrium. Applications to dissociating gases, to mixtures, and to the phenomenon of "choking" in a DeLaval nozzle are given special consideration. For cases when application of the criteria predict nonequilibrium, equations are provided in a form useful for numerical forward integration along streamlines.

533.6.01

2146. SOME STATIONARY RELATIVISTIC MOTIONS OF A GAS IN A CONDUCTING MEDIUM. K.P.Stanyukovich.
Zh. eksper. teor. Fiz., Vol. 35, No. 3(9), 762-5 (1958). In Russian.

Quasi-one-dimensional relativistic stationary gas flows in a medium possessing an infinitely high conductivity are considered for the case when a magnetic field perpendicular to the velocity is present. In particular motions with cylindrical symmetry are considered. The total momentum (equal to the "reactive" force) which an expanding gas can acquire in the presence of a field as well as in its absence is calculated. In particular the magnitude of the momentum during the outflow of an ultrarelativistic gas is considered.

533.6.011.3

2147. AN APPLICATION OF THE WEBER—ORR TRANSFORM TO THE PROBLEM OF TRANSONIC FLOW PAST A FINITE WEDGE IN A CHANNEL. J.B.Helliwell.
Proc. Cambridge Phil. Soc., Vol. 54, Pt 3, 391-5 (July, 1958).

An examination of the flow pattern developed around a wedge, symmetrically placed in a channel with parallel walls, for a compressible fluid at high subsonic velocities. In the transonic flow past a wedge, if the wedge angle or the free subsonic stream velocity is too small, no supersonic region develops on the side of the wedge, and the flow breaks away from the wedge shoulder, giving a free streamline. By applying the Weber—Orr transform, equations are obtained for the streamlines. An integral is obtained, from which the drag coefficient may be obtained by numerical methods, and an expression is developed for the semi-width of the wake. The method is also applicable to the problem of a jet of fluid issuing through a nozzle into a region of constant pressure. P.G.Morgan

533.6.011.311

2148. BOUNDARY CONDITIONS OF FLOWS ACCOMPANIED WITH SLIP ON WALL SURFACES. T.Koga.
Mem. Fac. Engng Nagoya Univ., Vol. 9, No. 2, 274-8 (Nov., 1957).

A distinction is drawn between values of velocity, density and stress at a boundary wall and their values in flowing gas at a distance of the order of the mean free path from the wall. Expressions for all these quantities are obtained in terms of two molecular distribution functions corresponding to classes of molecules reflected in two different ways at the wall. J.G.Oldroyd

MOLECULAR THEORY OF GASES

533.7

2149. KINETIC THEORY OF NONSPHERICAL MOLECULES. III. C.Muckenfuss and C.F.Curtiss.
J. chem. Phys., Vol. 29, No. 6, 1257-72 (Dec., 1958).

For Pt II, see Abstr. 7666 (1957). The theory is extended to multicomponent mixtures. The treatment is based on a set of generalized Boltzmann equations analogous to that used in the treatment of a pure gas, which are solved by a perturbation method similar to that of Chapman and Enskog. The transport coefficients are obtained in terms of a set of multidimensional integrals which depend on the dynamics of collisions of nonspherical molecules. These integrals are related to the "bracket" integrals of Chapman and Cowling and are generalizations of similar integrals which appear in the treatment of a pure gas of nonspherical molecules. These integrals are reduced to four-dimensional integrals, the integrands of which depend only on the geometry of the molecules, and the integrations are carried out over the surfaces of the two molecules. As an example, the final integrations are carried out for the spherocylindrical model. The coefficients of diffusion, thermal diffusion, shear and bulk viscosity, and thermal conductivity for a binary system are obtained in terms of two parameters characteristic of the shape and mass distribution of each molecule. The coefficient of self-diffusion is used to compare the thermal conductivity of a pure gas with that given by a modified form of the Eucken approximation.

533.7

2150. THERMAL RELAXATION IN GASES: A NEW METHOD OF ANALYSING THE EXPERIMENTAL DATA. A.C.J.Johnson.
Proc. Phys. Soc., Vol. 73, Pt 2, 273-9 (Feb., 1959).

It is shown that in the case of a single relaxation in a gas the relaxation time can be found in a simple manner if measurements are made of both the acoustic velocity dispersion and the absorption per wavelength. The problem is reduced to one of fitting circles and straight lines to the data. In the case of a multiple relaxation it is shown how the individual relaxation times can be found. The method is applied to some published results in a few gases to show the working of the method in practice.

533.7 : 530.162 : 530.145

CONTRIBUTION TO THE THEORY OF THE FERMI LIQUID.
See Abstr. 2084

533.7 : 532.7

CORRELATIONS IN A QUANTUM FLUID IN EQUILIBRIUM.
See Abstr. 2135

VIBRATIONS . ACOUSTICS

534.131

2151. PULSATION OSCILLATIONS OF CAVITIES IN RUBBER. E.Meyer, K.Brendel and K.Tamm.
J. Acoust. Soc. Amer., Vol. 30, No. 12, 1116-24 (Dec., 1958)

The oscillation behaviour of a spherical cavity in an infinite elastic medium is calculated for the case of an incident spherical dilational wave entirely reflected at the cavity walls. It is shown that there exists for every Poisson's constant $0 \leq \sigma \leq 0.5$ a frequency for which the amplitude of the oscillating cavity walls becomes a maximum. It is also shown that the amplitude resonance curves ar symmetrical and that, assuming loss-free material, they have a finite half-width, which is caused by radiation losses and depends only on the ratio of shear wave and dilational wave velocity. Pulsation oscillations of spherical, rotational-elliptical, cylindrical and cubic cavities in rubber blocks were examined experimentally. The pulsation oscillations were excited by means of a sound source coupled to the surface of the rubber block. The sound pressure inside the cavities was measured with a probe microphone. The experimental results for spherical cavities are compared with the theory. Good agreement is found with respect to the resonance frequencies.

534.131 : 539.43

2152. ON THE FATIGUE FAILURE OF STRUCTURES DUE TO VIBRATIONS EXCITED BY RANDOM PRESSURE FIELDS. A.Powell.
J. Acoust. Soc. Amer., Vol. 30, No. 12, 1130-5 (Dec., 1958).

On the assumption that the forced modes of vibration of a struc ture, subjected to pressure fluctuations random in time and space, can be approximated by the composition of the motions of the uncoupled natural modes, a general analysis is made using the ideas of vibration theory and spectrum analysis. The power spectrum, and hence the r.m.s. value, of any quantity depending linearly upon structural distortions is derived and it involves a quantity (called the "joint acceptance") concerning the spacewise structure of the pressure field and of the geometry of the modes of vibration. It is shown how this result may be used (on assuming "normal" randomness) to estimate the fatigue life on the hypothesis of cumulative damage.

534.13

2153. ON THE APPROXIMATION TO THE "INFINITE" SOLUTIO BY THE METHOD OF NORMAL MODES FOR RANDOM VIBRATION A.Powell.
J. Acoust. Soc. Amer., Vol. 30, No. 12, 1136-9 (Dec., 1958).

If a plane sheet (membrane of plate), which is excited by homogeneous random pressures, is assumed to be infinite in extent then a very direct method of analysis is possible. However, several important applications concern structures which are far from infinite in extent (e.g., the excitation of panels by boundary layer pressure fluctuations, and the problem of structural vibrations due to jet noise). This restriction may be overcome by using the method of normal modes, which is more cumbersome by its very nature. It turns out that if it is the power spectrum of displacement which is required, then the "infinite" approach can be used only when the sheet is large enough for there to be only negligible reflections fron its edges. However, if one is concerned only with the average mear square value of displacement (or related quantities), and if the detailed shape of the spectrum is of no consequence, then the infinite solution may be used, regardless of the magnitude of the damping, provided that the gravest modes are not excited.

534.13

2154. VIBRATIONS OF A SYSTEM WITH A FINITE OR AN INFINITE NUMBER OF RESONANCES. E.J.Skudrzyk.
J. Acoust. Soc. Amer., Vol. 30, No. 12, 1140-52 (Dec., 1958).

The study is based on the general differential equation of a mechanical system. Driving force and solution are expressed as a series of natural functions of the dissipationless system. Dissipation is taken into account by introducing complex elastic constants. The mode parameters are computed for rods, membranes, plates, and shells for three situations — a point force, a linear force distribution, and a force distribution given by a Fourier integral. The results make it possible to handle complicated mechanical systems with almost the same ease as simple mass points, and to compute their sound radiation.

534.131 : 534.232

2155. SOUND RADIATION OF A SYSTEM WITH A FINITE OR AN INFINITE NUMBER OF RESONANCES.

E.Skudrzyk.

J. Acoust. Soc. Amer., Vol. 30, No. 12, 1152-8 (Dec., 1958).

In a previous paper (see preceding abstract) the motion of a complex mechanical system was studied. The present paper deals with the sound radiation of such a system.

534.2 : 538.27

2156. COUPLED MAGNETOELASTIC WAVES IN FERROMAGNETICS AND FERROACOUSTIC RESONANCE.

A.I.Akhiezer, V.G.Bar'yakhtar and S.V.Peletminskiĭ.

Zh. eksper. teor. Fiz., Vol. 35, No. 1(7), 228-39 (1958). In Russian.

A phenomenological theory of coupled magnetoacoustic waves in ferromagnetics and ferrites is presented (the coupling between the elastic and magnetic waves being due to spontaneous magnetization). Sound velocities in the ferromagnetic which depend on the magnetization and strength of the applied magnetic field are determined. The absorption coefficient of sound due to electrical conductivity and relaxation of the magnetic moment is determined. A possibility of resonance excitation of magnetic waves with the aid of ultrasound is indicated.

534.2 : 532.5 : 538.3

EXCITATION OF MAGNETOACOUSTIC WAVES. See Abstr. 1608

534.21

2157. DETERMINATION OF THE FORM OF FINITE AMPLITUDE ULTRASONIC WAVES BY LIGHT REFRACTION.

M.A.Breazeale, B.D.Cook and E.A.Hiedemann.

Naturwissenschaften, Vol. 45, No. 22, 537 (1958).

Short description of the determination of the time variation of the sound pressure gradient, using a slit and photomultiplier tube to measure the deviation of a light beam which has passed through the sound field. H.D.Parbrook

534.213 : 551.5

2158. INSTRUMENTATION FOR STUDY OF PROPAGATION OF SOUND OVER GROUND.

F.M.Wiener, K.W.Goff and D.N.Keast.

J. Acoust. Soc. Amer., Vol. 30, No. 9, 860-6 (Sept., 1958).

An instrumentation system has been developed to allow continuous determination of the relevant micrometeorological parameters of the atmosphere near the ground in order to relate them to the measured attenuation of an acoustic signal propagated along the ground. Arrays of precision cup anemometers and shielded thermocouples mounted on a 30 ft tower were used to obtain the mean wind and temperature gradients above the ground. To obtain a measure of the atmospheric turbulence, a high-speed wind vane and a bead thermistor were used. The electrical signals obtained from scanning these transducer arrays were fed into a mobile central recording and control facility. Simultaneously, the information provided by the acoustic signal was recorded there by scanning the output of several microphones placed along two test courses each approximately one mile long. The mobile laboratory also contained the necessary equipment for energizing two loudspeakers, one for each test course. This paper discusses the micrometeorological instrumentation in some detail, together with the calibration techniques used. Typical mean wind and temperature profiles as well as turbulence spectra are presented. The relation of the micrometeorological data to the propagation of sound along the ground is discussed elsewhere.

534.213

2159. PROPAGATION OF SOUND IN PLATE-SHAPED SOLID DELAY LINES.

P.M.Sutton.

J. Acoust. Soc. Amer., Vol. 31, No. 1, 34-43 (Jan. 1, 1959).

Acoustic propagation in plate-shaped solid delay lines is analysed using diffraction theory. The analysis yields the dependence of group velocity (time delay), phase velocity, pulse shape, pulse rise time, output amplitude ripple spacing, and ripple amplitude on the parameters of frequency, delay line length, free-medium sound velocity, and plate thickness. Data are presented corroborating the theory quantitatively for time-delay dependence on frequency and plate thickness, ripple-spacing dependence on frequency and mode, and pulse rise-time dependence on frequency. The diffraction theory is compared to the wave equation plane-wave solutions for infinite plates. The results of the diffraction analysis are more appropriate for the description of sound propagation in plate-shaped delay lines.

534.22

2160. TABLES OF THE SPEED OF SOUND IN WATER.

M.Greenspan and C.E.Tschiegg.

J. Acoust. Soc. Amer. Vol. 31, No. 1, 75-6 (Jan., 1959).

An equation and tables for the speed of sound in water are reprinted from a paper published in J.Res. Nat. Bur. Stand., (Abstr. 2896/1958).

534.22

2161. EMPIRICAL FORMULA FOR SOUND VELOCITY IN LIQUID MIXTURES.

O.Nomoto.

J. Phys. Soc. Japan, Vol. 13, No. 12, 1528-32 (Dec., 1958).

An empirical formula

$$V = (R/v)^3 = \{(n_A R_A + n_B R_B)/(n_A v_A + n_B v_B)\}^3$$

was derived for the sound velocity in binary liquid mixtures, consisting of two component liquids A and B, on the assumption of the linear dependence of the molecular sound velocity $R = vV^{1/3}$ (where v is the molar volume and V the sound velocity) on concentration (molar fractions n_A, n_B) and the additivity of the molar volume. The suffixed quantities correspond to the component liquids. This formula holds for mixtures for which the linearity of the molecular sound velocity and the additivity of the molar volume is comparatively good, examples being the mixtures of two hydrocarbons and those of two monovalent alcohols. The values of the empirical sound velocity were compared with those calculated by this formula for 38 mixtures with comparatively small values of the percentage deviation from linearity of R, and 28 of them showed deviations not larger than 1% in V. Of the 31 liquid mixtures with $\Delta R/R \leq 0.3\%$, 5 showed deviations of V larger than 1%, 4 of them being the mixtures consisting of two component liquids of widely different molar volumes.

534.22

2162. MEASUREMENT OF THE VELOCITY OF ULTRASOUND WAVES IN FLUIDS UNDER PRESSURE BY THE PULSE METHOD.

A.V.J.Martin.

J. Rech. Cent. Nat. Rech. Sci., No. 41, 251-72 (Dec., 1957). In French.

The apparatus is described and results are reported for the propagation in argon, nitrogen, distilled water and standard sea water in the ranges from 1 to 1200 atm and from 25°C to 100°C. No dispersion was found in argon or in nitrogen. An accuracy of better than 4 parts in a 1000 is claimed for the measurements in distilled and sea water. H.D.Parbrook

534.22

2163. THE VELOCITY OF SOUND IN EMULSIONS.

P.A.Allinson.

J. Colloid Sci., Vol. 13, No. 6, 513-21 (Dec., 1958).

The velocity of sound in emulsions of benzene in water was measured, the viscosity of the continuous phase being varied by the addition of glycerine to the water, and the density of the disperse phase varied by the addition of carbon tetrachloride to the benzene. The results so obtained were compared with two theories, one assuming the emulsions to be homogeneous mixtures of the two components of a mean density and compressibility, the second derived from considerations of the scattering of sound energy from the suspended particles. The experimental results lay close to the values derived from the first assumption.

534.22 : 532.77

2164. INVESTIGATION OF ULTRASONIC VELOCITIES IN ORGANIC SOLUTIONS.

B.Ramachandra Rao and K.Subba Rao.

Proc. Phys. Soc., Vol. 73, Pt 2, 239-43 (Feb., 1959).

This paper embodies the results of the investigation of ultrasonic velocity, adiabatic compressibility and molar sound velocity R in solutions of benzoic acid, phthalic acid and salicylic acid in some organic liquids and its variation with concentration. Measurements of ultrasonic velocity were made by a precision double-crystal interferometer method. Molar sound velocity of the three solutes obtained by extrapolating the R against molar concentration graphs were interpreted in terms of the method of bond and atomic velocity increments given by Lagemann and Rao respectively.

534.222.2

2165. PROPAGATION OF DETONATION WAVES IN THE PRESENCE OF A MAGNETIC FIELD.

É.Larish and I.Shekhtman.

Zh. eksper. teor. Fiz., Vol. 35, No. 1(7), 203-7 (1958). In Russian.

It is shown that relativistic detonation waves in a magnetic field possess properties which are similar to those of the ordinary waves. Solutions of the equations at the discontinuity are presented for the relativistic and non-relativistic cases.

534.222.2 : 536.42

PHASE CHANGES OCCURRING IN WATER WHEN COMPRESSED BY STRONG SHOCK WAVES. See Abstr. 1372

534.222.2 : 537.56

OBLIQUE SHOCK WAVES IN A PLASMA. See Abstr. 1558

534.23

2166. ORIGIN OF ULTRASONIC RELAXATION IN CHEMICALLY ACTIVE MEDIA. G.S.Verma.

J. chem. Phys., Vol. 29, No. 5, 1186-7 (Nov., 1958).

A new mechanism is suggested to explain the presence of a secondary relaxation frequency known to occur in some 2,2-valent electrolytes at about 200 Mc/s. W.Good

534.23

2167. ULTRASONIC ABSORPTION AND THERMAL RELAXATION IN CO_2. M.C.Henderson and J.Z.Klose.

J. Acoust., Soc. Amer., Vol. 31, No. 1, 29-33 (Jan., 1959).

Measurements of ultrasonic absorption were made in dry CO_2 and in CO_2 with hydrogen admixtures, between 19°C and 146°C and a at pressures from 0.1 to 650 atm, and frequencies from 300 kc/s to 7 Mc/s. The absorption is described within experimental error by the relaxation formula throughout this range using either (a) a single relaxation time and a single relaxing specific heat representing the total of the vibrational modes, or (b) two relaxation times somewhat more than a factor of two apart, and two relaxing specific heats given by certain combinations of the component vibrations. The relaxation time, or times, vary inversely as the density throughout. The maximum absorption per wavelength comes at 32 kc/s per atm at 25°C. Addition of hydrogen shifts the CO_2 relaxation time by 110 kc/s per 1% by volume of H_2; this amount is in agreement with the shift determined by Knudsen and Fricke, provided their data is interpreted as being by volume and not by weight. The "classical absorption" at low pressures is 1.5 times the theoretical value.

534.23 : 538.245

2168. TEMPERATURE DEPENDENCE OF THE ABSORPTION OF ULTRASOUND IN A NICKEL SINGLE CRYSTAL FROM 77° TO 650°K. F.G.West.

J. appl. Phys., Vol. 29, No. 3, 480-2 (March, 1958).

The temperature dependence of the difference between the demagnetized and saturation ultrasonic absorptions was measured between 77° and 650°K. From 77° to above 400°K, at 10 Mc/s, this difference is found to be inversely proportional to the first-order magnetocrystalline anisotropy constant K_1 to approximately the first power. This result shows the inadequacy of present theories of absorption based on microeddy current losses accompanying domain wall motion and domain rotation. Further evidence is presented which seems to definitely exclude the rotation mechanism for this frequency range in nickel.

534.23

2169. A METHOD OF STUDYING THE VARIATION WITH TEMPERATURE OF ULTRASONIC ABSORPTION IN LIQUIDS.

B.R.Ramachandra Rao and H.S.Rama Rao.

Nature (London), Vol. 182, 1794-5 (Dec. 27, 1958).

This was determined using a two crystal fixed path interferometer; the effective path length was varied by changing the temperature. Results in four viscous liquids are presented. H.D.Parbrook

534.23

2170. ULTRASONIC ABSORPTION IN SOME HOMOLOGOUS SERIES OF ORGANIC LIQUIDS.

S.Parthasarathy, M.Pancholy and A.F.Chhapgar.

Nuovo Cimento, Vol. 10, No. 1, 111-31 (Oct. 1, 1958).

Results of ultrasonic absorption and velocity measurements in homologous series of fatty acids and alkyl acetates conducted over a range of frequency and temperature are reported. It is shown that the magnitude of the observed absorption and the relaxation frequency bear a relationship to the molecular weight in the series. It is also shown that the relaxation frequency in esters is the same for a common carboxyl group but depends on the molecular weight in a series of esters with different carboxyl radicals. Values of absorption coefficient and velocity in a number of saturated hydrocarbons, 1-olefins and aromatic hydrocarbons are reported. The relationship between the molecular weight on the one hand and the absorption coefficient and velocity together with their temperature coefficients on the other are discussed for the three series. It is suggested that while in the saturated and unsaturated aliphatic hydrocarbons the excess absorption is due partly to thermal relaxation and partly to bulk viscosity, in the case of aromatic hydrocarbons it is mainly due to thermal relaxation.

534.2

2171. ULTRASONIC ATTENUATION AND DISPERSION IN METALS AT LOW TEMPERATURES. M.S.Steinberg.

Phys. Rev., Vol. 111, No. 2, 425-9 (July 15, 1958).

The effect of conduction electron transport on the propagation of acoustic waves in normal metals is investigated at all frequencie For the attenuation, comparison is made with the kinetic analysis of Pippard and with the measurements of Bömmel. The fractional shift in the velocity of sound is found to be positive and very small.

534.23

2172. ABSORPTION OF SOUND IN SEDIMENTS OF SMALL PARTICLES IN LIQUIDS. K.Barron and L.E.Lawley.

Proc. Phys. Soc., Vol. 72, Pt 6, 933-9 (Dec., 1958).

The absorption of sound in sediments of particles in different liquids is investigated as the particle size is varied. A pulse metho is used at a constant frequency of 1 Mc/s. The sediments consist o small glass spheres of uniform size, eight different particle sizes in the range from 0.0035 cm to 0.016 cm radius being used in each liquid. The liquids used are water, carbon tetrachloride, benzene and castor oil. It is found that in all cases the absorption coefficient can be represented by an expression of the form $2\alpha = k_1a^3 + k_2/a^2 + k_3/a^2$ where k_1, k_2 and k_3 are constants which var with the liquid used. Some support for an equation of this form is obtained from Sewell's equation applicable to particles suspended in a fluid. At large particle sizes the most important term is k_1a^3 whi is due to scattering losses whereas at small particle sizes the last two terms due to viscous losses predominate. Where the k_3 term is significant it is found to be negative, the viscous absorption rising to a maximum and decreasing sharply as the particle size diminishe

534.23 : 537.312.6

2173. ULTRASONIC ATTENUATION IN SUPERCONDUCTING AN NORMAL MERCURY. L.Mackinnon and A.Myers.

Proc. Phys. Soc., Vol. 73, Pt 2, 291-6 (Feb., 1959).

The relative attenuation of 10 Mc/s longitudinal ultrasonic wave was studied in superconducting and normal mercury over the temperature range 1.17°K to 4.2°K. The marked difference in the atten ation for the two states, previously noted for other superconductors is also observed here, and is not inconsistent with energy-gap theor In the normal metal, the attenuation increases rapidly as the temper ture decreases, but it is difficult to estimate its "zero-field" value as there is a marked magnetic field dependence; in particular, an unusual increase in attenuation was observed at the lower temperature with a transverse field. There is no theory of this last effect.

534.23

2174. DETERMINATION OF ULTRASONIC ABSORPTION AND REFLECTION COEFFICIENTS IN DRY CO_2 FREE AIR. B.Özdoğar

Rev. Fac. Sci. Univ. Istanbul C, Vol. 21, No. 3, 233-40 (July, 1958).

An interferometer is employed in which a quartz crystal vibrates at one end of a column of air free from CO_2. The vibratio frequency is 508 kc/s and the Q factors of the system are determin at two reflector distances and at resonance, antiresonance and with the column evacuated. The amplitude coefficient of absorption of dry air at 25°C is deduced from these Q values and found to be 0.067 cm^{-1}. The exponential amplitude coefficient of reflection is found to be 0.015, the intensity coefficient of reflection 0.9705 and the reflection loss 0.030. The results obtained are compared with those of other experimenters at other frequencies and found in good agreement. It is concluded that the Q factor technique is reliable. A.C.Whiffi

534.23 : 621.395.

2175. SOUND ABSORPTION OF GROOVED POROUS SHEETS. J.Tichý.

Slaboproudy Obzor, Vol. 19, No. 10, 690-3 (1958). In Czech.

The absorbing sheet is assumed to be fixed to a solid wall. Th front face of the sheet contains a number of parallel grooves whose depth is smaller than the thickness of the material; the surfaces between the grooves are coated with a smooth reflecting material (e.g. metal strips). It is shown that the specific impedance of such sheets can be expressed by

$$z = \frac{a}{h}(z_1 - jk\rho c\delta_0),$$

where h/a is the ratio of the area occupied by the grooves to the total area of the sheet, k the wave number, ρ the density of the air, c the velocity of sound, δ_0 a correction factor, and z_1 the input impedance of a groove. The equation can be used to evaluate z on the basis of the characteristics of the material and the geometry of the sheet. Some measurements were made on absorbing sheets of felt and it was found that the theory was in good agreement with the experimental data. R.Sidorowic

534.231 : 532.525

2176. STATISTICAL EVALUATION OF NEAR-FIELD SOUND PRESSURES GENERATED BY THE EXHAUST OF A HIGH-PERFORMANCE JET ENGINE. E.C.Kamps.
J. Acoust. Soc. Amer., Vol. 31, No. 1, 65-7 (Jan., 1959).

The operation of modern, high-performance turbojet engines creates an environment that promotes rapid structural fatigue in many areas in jet aircraft. To facilitate the simulation of a valid test environment and, therefore, enable fatigue resistant structure to be readily developed, the characteristics of the near-field sound pressures created by the jet stream must be established. This study is concerned with the establishment of the level and the rate of occurrence of peak pressures in relation to the commonly measured r.m.s. level. A method is presented which enables the determination of these qualities from r.m.s. sound pressures recorded on magnetic tape. Also included are typical results obtained from near-field sound pressures generated by the jet exhaust of a turbojet engine. Noted conclusions: (1) Occurrence of peak pressures does not follow a Rayleigh distribution. (2) Peak pressure distribution is not altered by the physical position related to the jet stream nor does it appear to be a function of frequency. (3) A maximum ratio of peak to r.m.s. pressure is shown to exceed four, but a physical limit is not established.

534.232

2177. EFFICIENCY OF A LINEAR ARRAY OF POINT SOURCES WITH PERIODIC PHASE VARIATION.
T.F.W.Embleton and G.J.Thiessen.
J. Acoust. Soc. Amer., Vol. 30, No. 12, 1124-7 (Dec., 1958).

The radiation efficiency of a uniform linear array of point sources with periodic phase variation is evaluated. Two different types of interference are found depending on whether the characteristic length of the phase variation is greater or less than the wavelength of the sound radiated. In its application to suction roll silencing in paper mills it is found to be less effective than a linear continuous phase variation.

534.232 : 535.214

THE OPTICO-ACOUSTIC EFFECT IN LIQUIDS. See Abstr. 1230

534.232 : 537.226.2

PROPERTIES OF BaTiO$_3$ AS TRANSDUCER MATERIAL. See Abstr. 1422

534.242

2178. ACOUSTIC RESONANCE OF AQUEOUS SOLUTIONS.
C.Sălceanu.
C.R. Acad. Sci. (Paris), Vol. 247, No. 13, 917-19 (Sept. 29, 1958). In French.

Experimental work at 1315 c/s to show that the length of the resonant liquid column is proportional to the concentration and that the constant of proportionality is proportional to the ratio of the molar energy to the molecular weight of the solute. Variations may be explained in terms of heats of solution. H.D.Parbrook

534.26

2179. SCATTERING OF HIGH-FREQUENCY SOUND WAVES IN POLYCRYSTALLINE MATERIALS. A.B.Bhatia.
J. Acoust. Soc. Amer., Vol. 31, No. 1, 16-23 (Jan., 1959).

The scattering, and hence attenuation, of plane dilatational and shear waves due to random orientation of the grains is calculated on the assumptions that (1) the wavelength is large compared to the grain size and (2) the variations in elastic moduli from grain to grain are small compared to the average values of these moduli for the bulk material. Previous treatments of this problem are incomplete; for incident dilatational waves they are valid for a fluid (rigidity modulus = 0), and for incident shear waves they describe inadequately the angular dependence of the intensity of the scattered shear waves. It is shown in this paper that for both of these types of incident waves both the scattered dilatational and shear waves are produced; the energy carried away from the incident beam by the latter is $\frac{3}{2}(V_l/V_s)^5$ times that by the former. Here V_l and V_s are the velocities of the dilatational and shear waves, respectively. The agreement between the theoretical and observed values of the attenuation coefficient is much better than that previously obtained by Mason and McSkimin. The attenuation due to local fluctuations in the density of a medium caused by thermal agitation is also calculated. For solids and liquids this effect is completely negligible. However, for a gas near its critical point, this attenuation is appreciable, and rises sharply as the critical point is approached.

534.321.9

2180. PHOTOGRAPHIC METHODS FOR THE REPRESENTATION OF THE ULTRASONIC FIELD. H.W. Kölle.
Exper. Tech. der Phys., Vol. 1, No. 3, 97-105 (1953). In German.

The autophotographic method is described and some results of the application of this method to cavitation luminescence are given.
S.Weintroub

534.321.9

2181. THE PROPAGATION OF ULTRASONICS IN POLYMER SOLUTIONS. I.G.Mikhaĭlov and N.M.Fedorova.
Vestnik Leningrad. Univ. (1958), No. 16, Ser. Fiz. Khim., No. 3, 78-88. In Russian.

The experiments consist in measuring the absorption with large and small amplitude waves in high polymer solutions. A pulse method is used and a frequency range of 5 to 35 Mc/s. At low amplitudes relaxation is observed over this range of frequencies and of larger magnitude for larger concentrations. At large amplitudes, beginning at some threshold amplitude, thirotropic destruction of the solution structure takes place. The threshold value referred to appears to vary with both solute and solvent. C.R.S.Manders

534.321.9 : 535.42

DIFFRACTION OF LIGHT BY ULTRASONIC WAVES. See Abstr. 1338-9, 1341

534.39 : 532.528

2182. CAVITATION MICROSTREAMING. S.A.Elder.
J. Acoust. Soc. Amer., Vol. 31, No. 1, 54-64 (Jan., 1959).

An attempt was made to discover by experiment what physical assumptions and approximations are appropriate in the theory of cavitation microstreaming, especially for cavitation bubbles located near solid boundaries. A systematic investigation of the phenomenon was made and its dependence on certain parameters (e.g. amplitude of sound) was determined. The investigation has disclosed that as the sound amplitude is varied, other conditions remaining the same, the streaming changes discontinuously through several stable regimes. It appears that in order to account for the generation of vorticity one needs to assume different conditions at the boundaries for each regime. For at least one regime, a theoretical model due to Nyborg seems to be applicable; comparison is made with experimentally determined streaming velocities.

534.4 : 537.221

2183. SPONTANEOUS ELECTRIFICATION OF DUST FIGURES IN A KUNDT'S TUBE. W.Staszewski and B.Adamczyk.
J. Acoust. Soc. Amer., Vol. 30, No. 10, 987-9 (Oct., 1958).

Evidence is presented that in a Kundt's tube under suitable conditions spontaneous electrification of dust particles takes place. Appreciable time is needed for the particles to acquire a measurable charge, the sign of which depends on the material of the tube as well as that of the dust.

534.612

2184. OPTICAL METHODS FOR THE MEASUREMENT OF THE SOUND PRESSURE IN LIQUIDS. M.A.Breazeale and E.A.Hiedemann.
J. Acoust. Soc. Amer., Vol. 31, No. 1, 24-8 (Jan., 1959).

In order to evaluate the method for measurement of the ultrasonic pressure amplitude in progressive waves which was developed by Loeber and Hiedemann (Abstr. 1929/1956) for stationary waves, a comparison between it and two other optical methods was made. Pressure measurements under identical conditions by the three methods are given. Experimental considerations for the use of optical methods for measurement of sound pressure amplitudes are discussed.

534.7

PHYSIOLOGICAL ACOUSTICS. HEARING. See also the Section entitled "BIOPHYSICS. PHYSIOLOGICAL PHYSICS".

534.782 : 612.85

2185. STUDY OF SOME CUES IN THE PERCEPTION OF THE VOICED STOP CONSONANTS. H.S.Hoffman.
J. Acoust. Soc. Amer., Vol. 30, No. 11, 1035-41 (Nov., 1958).

Previous research involving synthetic speech reveals that both the second-and the third-formant transitions play a role in the perception of the voiced stops, |b|, |d|, and |g|. The present experiment examined an additional cue (burst frequency), repeated a portion of the previous research, and collected more information about how the cues act in various combinations. Synthetic speech sounds containing one cue, all possible combinations of two cues, and all possible combinations of three cues were tested on a large group of listeners. Burst frequency was found to act as a cue for the perception of the voiced stops in much the same manner as this variable affects the perception of the unvoiced stops. To the extent that the present experiment overlapped previous research, the two sets of findings were in very close agreement. When cues were combined, they shared in the control of perception in such a way that the contribution of any one cue was largely independent of the nature and the number of the other cues present in the sound. The individual cues seemed to have directional properties somewhat like vectors. The addition of cues produced effects somewhat like the addition of vectors.

534.845.1

2186. AMERICAN STANDARD RECOMMENDED PRACTICE FOR LABORATORY MEASUREMENT OF AIR-BORNE SOUND TRANSMISSION LOSS OF BUILDING FLOORS AND WALLS.
K.U.Ingard, R.Huntley, W.A.Jack, M.B.Summerfield, F.Tyzzer and R.V.Waterhouse.
J. Acoust. Soc. Amer., Vol. 31, No. 1, 76-8 (Jan., 1959).

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535.07

2187. RECORDING ELECTRONIC LENS BENCH. D.R.Herriott.
J. Opt. Soc. Amer., Vol. 48, No. 12, 968-71 (Dec., 1958).

The measurement of lens characteristics by the method of contrast rendition of a sine-wave target was studied extensively in recent years. This method has not, however, been widely used because of the time required to measure a lens at many field angles and focal positions as well as the time required to reduce the data to suitable form. These limitations are caused by poor signal-to-noise ratio from the photoreceptor when operating at reduced lens aperture or with wavelength limiting filters. A system is described which uses sweep frequency sine-wave targets with rectification and filtering of the electrical signal to reduce the required bandwidth thereby overcoming these difficulties. Rapid scanning with oscilloscope presentation is used for preliminary adjustment of lens parameters. An X—Y recorder combines curves for a number of lens adjustments on preprinted paper for permanent records at a rate of 10 sec per curve.

535.14 : 539.12

2188. FLUCTUATIONS OF PHOTON BEAMS AND THEIR CORRELATIONS. L.Mandel.
Proc. Phys. Soc., Vol. 72, Pt 6, 1037-48 (Dec., 1958).

The distribution of counts from a photoelectric detector illuminated by light of bandwidth $\Delta\nu_0$ is analysed by associating the photons with Gaussian random waves. This is shown to lead to a full statistical description of the counts. It is shown that the number n_T in a time interval $T \ll 1/\Delta\nu_0$ obeys pure Bose—Einstein statistics, and that the fluctuations in longer intervals $T \gg 1/\Delta\nu_0$ are simply the density fluctuations of a boson assembly in a phase space of $\sim \Delta\nu_0 T$ cells. The correlation coefficient ρ of the fluctuations of counts from two detectors illuminated by partially coherent beams is found to be proportional to the local time average of the square of the coherence function (γ_{12}^2). The correlation is shown to depend on the degeneracy of the beams in such a way that $\rho \to 2(\gamma_{12}^2)$ for highly degenerate beams. The results are all consistent with those obtained by Hanbury Brown and Twiss (Abstr. 8852/1954, 2009/1956 and 2932-3/1958).

535.23.08

2189. CONTINUOUSLY RECORDING SPECTRORADIOMETER.
D.L.MacAdam.
J. Opt. Soc. Amer., Vol. 48, No. 11, 832-40 (Nov., 1958).

A spectroradiometer is described for recording the spectral distribution of daylight or of any artificial light source that radiates steadily for 3.5 min. Beams from the external source and from an internal standard lamp are deviated alternately through a monochromator to a multiplier phototube. The collimator consists of parallel baffles instead of a mirror or lenses. The amplified signal activates a motor which moves a mirror to attenuate the energy from the internal standard until the beams are equal. The necessary degree of attenuation is then recorded while the wavelength is being changed. The logarithm of the spectral distribution of the internal standard may be added electrically to the logarithm of the measured attenuation to record directly the logarithm of the absolute energy radiated by the sample. The spectral distribution of sources with luminances as low as 1 ft L have been measured with a half-maximum band width of 10 mμ. The spectral emittance of a variety of phases of daylight and sunlight, at different times of the year and under various weather conditions, as well as of fluorescent lamps, electroluminescent panels, and ultraviolet-excited fluorescent coatings, have been recorded and are summarized here.

535.23.08 : 536.5

2190. A PRECISION, DIRECT-READING, COLOUR TEMPERATURE METER. P.Hariharan and M.S.Bhalla.
J. sci. Instrum., Vol. 35, No. 12, 449-52 (Dec., 1958).

The measuring element in the instrument is a photomultiplier tube operated in a logarithmic difference circuit which views, alternately through red and blue filters, a diffuser illuminated by the lamp which is being calibrated. The output from the circuit is linearly proportional to the reciprocal of the colour temperature of the lamp and is independent of its brightness. Readings can be made with an accuracy of approximately ±5 deg K over the colour temperature range from 2200° to 3200° K.

535.24

2191. INCOMPLETE INTEGRATING SPHERE.
O.E.Miller and A.J.Sant.
J. Opt. Soc. Amer., Vol. 48, No. 11, 828-31 (Nov., 1958).

An expression is developed for the radiance of the sphere wall as a function of the incident flux F_0, the reflectance R, and the ratio α of the remaining sphere-wall area to the total area of the sphere. The theory holds for the limiting cases $\alpha \to 1$ and $\alpha \to 0$. Excellent agreement was found by experiment among several determinations of absolute reflectance for widely different values of α.

535.241.39

2192. STANDARD PLANE SOURCE OF LIGHT OBEYING LAMBERT'S LAW AND OF UNIFORM LUMINANCE.
G.Gergely and J.Ádám.
Optik, Vol. 15, No. 7, 429-33 (July, 1958). In German.

The source is a plane diffusing window in a photometric integrating sphere. It is used as a comparison source for measuring the luminance and colour of luminescent screens. The colour is altered by means of glass filters. The approximation to a uniform diffuser is good within 40° from the normal. J.W.T.Walsh

535.315

2193. RESOLVING POWER OF AN ABSORBING PRISM.
D.B.Agarwal and K.C.Chaturvedi.
Optik, Vol. 15, No. 9, 574-81 (Sept., 1958).

Discusses the variations of resolving power of a prism with background intensity, stage of resolution desired, the detecting instrument and the absorption coefficient of the material of the prism, when natural line width is negligible.

535.316

2194. ON THE TRANSVERSE CHROMATIC ABERRATION OF OPTICAL SYSTEMS. A.Biot.
Ann. Soc. Sci. Bruxelles I, Vol. 72, No. 3, 107-17 (1958). In French.

A formula is obtained for the transverse colour for any pair of conjugate points in terms of the chromatic variations of the principal foci and the pupil points. It is applied to a combination of thin lenses, a thick lens, a plane refracting surface, a spherical refracting surface and a hyper-hemispherical front component of a microscope objective. W.T.Welford

535.31

2195. MARGINAL PERFORMANCE OF CORRECTED OPHTHALMIC LENSES. F.E.Washer and W.R.Darling.
J. Res. Nat. Bur. Stand., Vol. 60, No. 6, 551-62 (June, 1958).

The measured values of the departures of the marginal meridional and cylindrical powers from the corresponding measured value of the axial powers for 311 corrected ophthalmic lenses are reporte The spherical refractive powers of the lenses studied range from +7.00 to −20.00 diopters with cylindrical powers of 0.00 to 4.00 diopters. The probable errors of measurement are discussed. A set of tolerance values is suggested, and the degree of compliance with these suggested tolerances is shown.

535.317.

2196. APODIZATION AND FREQUENCY RESPONSE WITH INCOHERENT LIGHT. J.A.Macdonald.
Proc. Phys. Soc., Vol. 72, Pt 5, 749-56 (Nov., 1958).

A study is made of the possibility of increasing the response o an optical system to a given spatial frequency by means of apodization, when the wave-front aberrations and defocusing are supposed to be known. By the usual methods of the calculus of variations, th condition for maximization of frequency response for variation of transparency is expressed as a functional equation, which may be approximated to by a linear second-order eigenvalue problem, for the transparency. Some examples are discussed.

535.328 : 539.2

DISPERSION OF LIGHT IN THE EXCITON ABSORPTION EGION IN CRYSTALS. See Abstr. 1857

535.33.07

197. EXPERIMENTAL INVESTIGATION OF THE EFFECT OF DJUSTMENT ERRORS ON PRISM MONOCHROMATORS. K.Lenz.
ptik, Vol. 15, No. 9, 565-73 (Sept., 1958). In German.

Because of their larger number of optical components and high perture ratios, monochromators are more sensitive to errors in djustment than spectrographs. The effect of various adjustment rrors upon the image of an emission line is investigated, and ample recordings are given to demonstrate typical errors.

R.W.Fish

535.331

198. ISOTOPE SHIFT IN THE ARC SPECTRUM OF ZINC.
.F.Hately and T.A.Littlefield.
. Opt. Soc. Amer., Vol. 48, No. 11, 851-3 (Nov., 1958).

The reflecting echelon interferometer was used to determine sotope shift in eleven wavelengths in the zinc arc spectrum between 000 A and 5000 A. Small quantities of enriched Zn 64, Zn 66, and n 68 isotopes were excited in Schüler type discharge tubes with quid nitrogen cooling. In this way isotope shifts well below the esolving limit of the echelon were investigated. The normal mass nd volume effects were calculated and subtracted from the observed sotope shift, the difference being attributed to the specific mass ffect. For the resonance lines 2139 A ($4s^2\ {}^1S_0$-$4s4p\ {}^1P_1$) and 3076 A $4s^2\ {}^1S_0$-$4s4p\ {}^3P_1$) the specific mass effect is larger than the normal ass effect and is in the same direction. The results confirm the ork of Crawford, Gray, Kelly, and Schawlow. For the other wave-engths investigated, the specific mass effect is slightly smaller than e normal mass shift and is in the opposite direction.

535.331 : 539.18

LOW EVEN CONFIGURATIONS IN THE FIRST SPECTRUM CF HENIUM (Re I). See Abstr. 1805

535.332 : 535.337

199. STARK EFFECT IN ARGON II. L.Maissel.
. Opt. Soc. Amer., Vol. 48, No. 11, 853-6 (Nov., 1958).

Stark effect shifts were measured for some twenty lines in the ltraviolet spark spectrum of argon. The apparatus used consisted f a hollow cathode discharge which acted as a source from which ons could be drawn into a field space. Fields up to 160 kV/cm could e obtained. All shifts observed were to the red and could be explained as being due to the combined effects of several nearby per-urbing energy levels acting simultaneously.

535.333 : 539.19

200. THE VISIBLE EMISSION SPECTRUM OF Cl_2^+.
.Venkateswara Rao and P.Tiruvenganna Rao.
anad. J. Phys., Vol. 36, No. 11, 1557-68 (Nov., 1958).

Two visible emission band systems attributed to the ionized molecule Cl_2^+ were studied using the second order of a 21 ft concave-grating spectrograph (dispersion 1.25 A/mm). Rotational analyses vere carried out for six bands of system I and six of system III for vhich new vibrational analyses were recently proposed by Haranath nd Rao. The rotational analyses of the bands of these two systems re consistent with the vibrational assignments. Rotational constants or the upper and lower states of the two systems have been derived. oth the vibrational and rotational analyses of systems I and III ndicate case (c) 1/2—1/2 and 3/2—3/2 transitions respectively for he two systems. Potential energy curves are drawn for the upper nd lower states of each of the two systems. The lower states dis-sociate into a normal $Cl(^2P) + Cl^+(^3P)$ while the upper states dissoci-ate into a normal $Cl(^2P)$ + an excited $Cl^+(^1D)$. It is suggested that he lower state of system III is probably the normal state of Cl_2^+ rom theoretical and experimental evidence.

535.333

2201. BAND SPECTRA OF MAGNESIUM OXIDE AND HYDROXIDE BETWEEN 4000 AND 3600 A. D.Pesic and A.G.Gaydon.
Proc. Phys. Soc., Vol. 73, Pt 2, 244-9 (Feb., 1959).

Band systems in the extreme violet were excited in "vacuum" arcs in oxygen, ordinary water vapour and heavy-water vapour, and also in a flame. Wavelengths of MgOH and MgOD bands are listed. An oxide system in the same region was studied under large dispersion but is too complicated to analyse; it is attributed to a poly-atomic emitter, possibly Mg_2O_2.

535.333

2202. EMISSION SPECTRUM OF CARBON MONOXIDE FROM 2.3 TO 2.5 MICRONS. E.K.Plyler, H.C.Allen,Jr and E.D.Tidwell.
J. Res. Nat. Bur. Stand, Vol. 61, No. 1, 53-6 (July, 1958).

The 2-0, 3-1, 4-2, 5-3 and 6-4 emission bands of carbon monoxide have been measured in the region from 4000 to 4360 cm^{-1} with a grating spectrometer. A 10 000 line per inch grating used in the second resolved lines separated by 0.08 cm^{-1}. Several sets of measurements were made on the 2-0 band and the molecular constants were calculated. The constants in cm^{-1} are $B_0 = 1.922\,511 \pm 0.000\,025$. $D_0 = 6.13 \pm 0.02 \times 10^{-6}$. Using these values and the B_0 from 1-0 band in conjunction with the microwave constant a new determination of the speed of light is obtained, $c = 299\,794 \pm 3$ kilometers per second.

535.34.07

2203. AN INFRARED CELL FOR SMALL GAS SAMPLES.
D.S.Russell.
Canad. J. Chem., Vol. 36, No. 12, 1745-6 (1958).

In order to obtain infrared spectra of very small gas samples, a glass absorption cell has been made to conform to the shape of the converging light beam of a Perkin-Elmer model 21 spectrophotometer. The cell described has a 5 cm light path and approximately one-tenth the volume of a conventional 5 cm cell.

D.L.Greenaway

535.34.07

2204. THE PRESENT STATE OF SPECTROPHOTOMETRY IN THE VISIBLE AND ULTRAVIOLET. R.Ritschl.
Exper. Tech. der Phys., Vol. 1, No. 4-5, 145-57 (Nov.-Dec., 1953). In German.

A general article describing instruments used in visible and u.v. spectroscopy. A short note on continuous light sources and discontinuous sources with sharp lines is followed by a section on spectrographs. Descriptions are given of a number of Soviet and German models of quartz and glass prism spectrographs. Monochromators discussed include several Soviet and German models.

C.Turner

535.34.07

2205. THE STATE OF SPECTRAL PHOTOMETRY IN THE INFRA-RED REGION. H.Jancke.
Exper. Tech. der Phys., Vol. 1, No. 4-5, 157-73 (Nov.-Dec., 1953). In German.

A review of instruments used in Germany, dealing with radiating sources, receivers, electronics and recording. A final section deals with the construction of some characteristic instruments with spectral resolution and non-dispersive devices. 27 references.

C.Turner

535.34.07

2206. A SIMPLE RECORDING DOUBLE-BEAM INFRARED SPECTROPHOTOMETER. G.Geppert.
Exper. Tech. der Phys., Vol. 5, No. 4, 175-9 (1957). In German.

An account of a spectrophotometer of more or less conventional design, employing only spherical mirrors. Reproducibility of the 10μ band of NH_3 can be obtained to better than 1% transmission and 0.01μ in wavelength.

R.C.Seymour

535.343

2207. STUDIES OF THE EFFECT OF OXYGEN ON THE SPECTRA OF BARIUM OXIDE FILMS. J.Cunningham.
J. chem. Phys., Vol. 29, No. 5, 1196-7 (Nov., 1958).

Annealed barium oxide films were exposed to oxygen for up to 3 hr at temperatures ranging from −150 to 200°C, and oxygen pressures of up to 10 mm. No alteration in the spectra was produced, although exposure to low pressures of water vapour at 20°C rapidly destroyed the characteristic barium oxide structure.

R.D.Hudson

535.343

2208. UPPER LIMIT TO THE INTENSITY OF THE 3400 A SINGLET—TRIPLET ABSORPTION IN BENZENE.
D.P.Craig, J.M.Hollas and G.W.King.
J. chem. Phys., Vol. 29, No. 4, 974 (Oct., 1958).

The absorption bands of benzene at 3400 A were investigated, using oxygen-free benzene. None of the previously reported bands could be detected using a wide range of liquid absorbing paths up to 22.5 m, giving an upper limit to the oscillator strength of the transition of $f = 7 \times 10^{-12}$.

R.D.Hudson

535.343 : 539.2

2209. INFRARED STUDIES ON POLYMORPHS OF SILICON DIOXIDE AND GERMANIUM DIOXIDE.

E.R.Lippincott, A.Van Valkenburg, C.E.Weir and E.N.Bunting.
J. Res. Nat. Bur. Stand., Vol. 61, No. 1, 61-70 (July, 1958).

The infrared spectra of coesite, low-temperature tridymite, low-temperature cristobalite, low-temperature quartz, vitreous silica, hexagonal GeO_2, tetragonal GeO_2, and vitreous germania are reported from 4000 to 300 cm^{-1}. Wherever possible an assignment of frequencies has been made on the basis of the selection rules for the crystal symmetry. Three characteristic group frequencies near 1100, 800 and 480 cm^{-1} are common to all the polymorphs of SiO_2. These frequencies respectively correspond to a stretching mode involving displacements associated primarily with the oxygen atoms, a stretching mode involving displacements associated primarily with the silicon atoms, and a Si—O bending mode. The presence of these group frequencies in coesite indicates that the coordination of silicon in coesite is tetrahedral and that its high density is associated with the packing of tetrahedral units at an angle approximating 120 degrees. The tetragonal and hexagonal GeO_2 polymorphs show a marked difference in spectra due in part to the change from sixfold to fourfold coordination. The assignment of observed frequencies in hexagonal GeO_2 is consistent with that made for low-temperature quartz if allowance is made for the heavier mass of the Ge atom.

535.343 : 539.19

VIBRATIONAL SPECTRA OF CS_2, CSe_2, SCSe, AND SCTe. See Abstr. 1821

535.343

2210. PREPARATION OF THIN CRYSTALLINE SAMPLES OF THE ALKALI HYDROXIDES FOR INFRARED ABSORPTION STUDIES.

K.A.Wickersheim.
J. chem. Phys., Vol. 29, No. 5, 1197-8 (Nov., 1958).

Thin alkali hydroxide samples were prepared by a method which affords protection from attack by atmospheric water vapour and carbon dioxide. The frequencies of infrared OH fundamentals measured using these samples agree well with those obtained previously with thin films formed by vacuum deposition. D.L.Greenaway

535.343

2211. LATTICE ABSORPTION BANDS IN SILICON.

F.A.Johnson.
Proc. Phys. Soc., Vol. 73, Pt 2, 265-72 (Feb., 1959).

A series of detailed measurements were made of the absorption spectrum of pure vacuum-grown crystals of silicon in the wavelength range 2 μ to 30 μ, and over the temperature range 20°K to 365°K. Some new absorption bands were found, and an explanation is offered for the positions and temperature dependence of all the principal absorption peaks in terms of multiple phonon interactions involving phonons with energies corresponding to temperatures of 200, 480, 595 and 695°K.

535.343

2212. INFRARED SPECTRA OF HIGH POLYMERS. VIII. POLYVINYL NITRATE. S.Krimm and C.Y.Liang.

J. appl. Phys., Vol. 29, No. 10, 1407-11 (Oct., 1958).

The spectrum was obtained in the extended region from 70 to 3600 cm^{-1}. Polarized infrared measurements were made on oriented specimens in the range of 350 to 3600 cm^{-1}. Since X-ray diffraction patterns indicate no crystallinity, the analysis has been based on an assumed atactic configuration. With the help of previous studies of high-polymer spectra and results obtained on small molecules, it has been possible to make a complete assignment of all of the expected fundamentals. Dichroic measurements have not only permitted a decision on the assignment of the controversial NO_2 rocking and bending modes, but suggest certain details concerning the local configuration of the nitrate group. There seems to be evidence that, although the specimen is not crystalline, a significant proportion of the chains have configurations not far from a planar zigzag chain.

535.343.9 : 535.337

2213. PRESSURE MODULATION OF INFRARED ABSORPTION. I. ENTIRE VIBRATION-ROTATION BANDS.

J.C.Gilbert and D.Williams.
J. Opt. Soc. Amer., Vol. 48, No. 11, 765-9 (Nov., 1958).

The effects of pressure modulation on the total absorption A(v)dv of rotation-vibration bands of carbon monoxide, nitrous oxide, methane, and propane were investigated. Although the ultimate limitations of pressure modulation as a detection technique have not yet been completely established, the present results are in qualitative agreement with predictions based on the earlier studies of Howard, Burch, and Williams. Modulation is of use in distinguishing weak absorption bands from background absorption in the atmosphere. In strong absorption bands, the wings are enhanced in the modulated spectrum; in weak bands, the modulated spectrum approximates that obtained by conventional methods. Possible applications of pressure modulation are suggested.

535.345

2214. INTRINSIC OPTICAL ABSORPTION IN SINGLE-CRYSTAL SILICON CARBIDE. H.R.Philipp.

Phys. Rev., Vol. 111, No. 2, 440-1 (July 15, 1958).

The optical absorption of single-crystal silicon carbide was measured in both the cubic and hexagonal, type 6H, modification. The curves nearly coincide for absorption coefficients above 10^3 cm^{-1}. At longer wavelengths the cubic structure absorbs more strongly. The absorption coefficient is 100 cm^{-1} at 2.62 and 3.12 eV respectively in these two crystals. The electron affinity of silicon carbide is estimated from photoelectric data to be about 4 eV.

535.345

2215. OPTICAL ABSORPTION IN P-TYPE GALLIUM ARSENIDE.

R.Braunstein and L.Magid.
Phys. Rev., Vol. 111, No. 2, 480-1 (July 15, 1958).

In p-type gallium arsenide, a number of absorption bands were observed on the low-energy side of the intrinsic absorption edge. The absorption spectrum has a distinct peak at 0.42 eV, a partially resolved peak at 0.31 eV and the beginning of a strong absorption band setting in at 0.25 eV. The main features of the spectra can be explained in terms of hole-transitions between different branches of the valence band of gallium arsenide. The transitions between light- and heavy-hole bands and a band split off by spin—orbit splitting are identified. The spin—orbit splitting is ~ 0.34 eV.

535.345 : 537.311.33

INFRARED ABSORPTION OF PHOTOGENERATED FREE CARRIERS IN GERMANIUM. See Abstr. 1456

535.345 : 539.2

OPTICAL ABSORPTION EDGE IN SILICON AND GERMANIUM. See Abstr. 1865

535.345 : 539.2

OPTICAL ABSORPTION BY F CENTRES IN ALKALI HALIDES. See Abstr. 1877

535.345 : 539.1.07 : 539.89

EFFECTS OF PRESSURE ON OPTICAL PROPERTIES OF DIAMONDS. See Abstr. 1914

535.371

2216. LUMINESCENT PHASES IN WILLEMITE FILMS.

C.Feldman and M.O'Hara.
J. Opt. Soc. Amer., Vol. 48, No. 11, 816-20 (Nov., 1958).

Red-, yellow-, and green-luminescent films were formed by evaporation of powdered Zn_2SiO_4[Mn]. The yellow-emitting form was formed by firing the evaporated film plus additive in air at relatively low temperatures (750°C). The red form was produced on Vycor substrates at higher temperatures (1100°C). Infrared reflection studies and X-ray diffraction analyses of these films indicate that the red-emitting form is SiO_2[Mn] and that the yellow form is amorphous Zn_2SiO_4[Mn]. The luminescence of both of these phosphors is probably due to interstitial manganese ions. The strong chemical reaction between the luminescent film and the glass substrate is brought out.

535.371 : 591.176

2217. ON THE FLUORESCENCE OF THE SKIN. K.Przibram.

Naturwissenschaften, Vol. 44, No. 14, 393-4 (1957). In German.

Handling of minerals leaves a blue-fluorescing material on them, and this fluorescence is increased by heating. A material of blue fluorescence is extracted from skin by water, and this becomes brighter if the skin has been heated previously to a high temperature. See Abstr. 6029-30 (1957). S.T.Henderson

535.371

2218. STRONTIUM CERATE WITH EMISSION IN THE VISIBLE.

H.Witzmann and E.Gegner.
Naturwissenschaften, Vol. 45, No. 19, 462 (1958). In German.

The strontium cerate emission extends over the whole visible spectrum. Admixture with some oxides or fluorides causes the emission intensity to decrease. J.Franks

535.371 : 539.2

2219. PARAMAGNETIC RESONANCE ABSORPTION IN NAPHTHALENE IN ITS PHOSPHORESCENT STATE.

C.A.Hutchison, Jr and B.W.Mangum.
J. chem. Phys., Vol. 29, No. 4, 952-3 (Oct., 1958).

Paramagnetic resonance was observed due to the optically xcited triplet state in solutions of naphthalene in single crystals f durene at 72° K. The half-life of the resonance, 3 sec, compares with that of the phosphorescence, 2.6 ± 0.2 sec. The triplet state an be described by the usual spin Hamiltonian for an effective spin f one; the crystalline Stark effect splits the triplet into its three omponents. It is estimated that the signal corresponds to 10^{14} molecules in the triplet state.
J.M.Baker

535.371

2220. FAST NEUTRON INDUCED LUMINESCENCE IN VITREOUS ILICA AND QUARTZ.

W.Primak and R.A.Uphaus.
. chem. Phys., Vol. 29, No. 4, 972-3 (Oct., 1958).

Neutron irradiated fused silica and quartz luminesce under ltraviolet excitation, with emission peaks at 550 mμ and 615 mμ. On annealing, colour changes occur, the emission is faint after eating above 900°C.
J.Franks

535.372

2221. THALLIUM-ACTIVATED ALKALINE EARTH BORATES WITH U.V. EMISSION.

H.Witzmann and J.Malur.
Naturwissenschaften, Vol. 45, No. 19, 462 (1958). In German.

The phosphors were fired in air at 800-900°C and excited by hort-wave ultra-violet. The thallium content affects the relative proportion of the 3100 and 3500 A emission bands; the curves also how another band between these two, and all three are emitted by ll the phosphors. The constituents were varied in the proportions $CaCO_3 : xH_3BO_3$ where x = 2, 3, 5, 6, 9, 12, and a general increase n luminescent efficiency followed the increase of x.
S.T.Henderson

535.372

2222. THE FLUORESCENCE OF DIAMONDS EXCITED BY X-RAYS.

I.G.Matthews.
Proc. Phys. Soc., Vol. 72, Pt 6, 1074-80 (Dec., 1958).

X-ray excited fluorescence spectra of type I and type II diamonds were recorded photographically. The spectra so obtained are broadly similar for all specimens but they differ from those found with ultraviolet (3650 A) excitation of the same specimens. The differences are described and a possible explanation is discussed.

535.376

2223. CATHODOLUMINESCENCE OF STRONTIUM OXIDE, BARIUM-STRONTIUM OXIDE, AND MAGNESIUM OXIDE.

H.Gandy.
Phys. Rev., Vol. 111, No. 3, 764-71 (Aug. 1, 1958).

A survey of some spectral and time decay properties of the cathodoluminescence of SrO, (BaSr)O, and MgO samples was made in sealed-off high-vacuum tubes in the spectral range from 220 mμ to 600 mμ. Observations were made for sample temperatures varying from 90°K to room temperature and above with the samples in different states of thermionic activity. In SrO samples, luminescence maxima were observed at photon energies of 4.9 eV, 3.7 eV, and 2.4 eV. The 4.9 eV band intensity increases with the thermionic activity of the sample whereas that of the 3.2 eV band decreases. Emission band maxima were found in (BaSr)O at energies of 4.0 eV, 3.1 eV, 2.6 eV, and 2.1 eV. A comparison of the (BaSr)O luminescence is made with that from SrO and BaO. MgO samples were studied in both polycrystalline and single crystal forms. Luminescence band maxima were observed at energies of 5.2 eV, 3.6 eV, 2.7 eV, 2.3 eV, and 2.1 eV. The 2.3 eV band may be enhanced by heating the sample in magnesium vapour or diminished by heating it in oxygen. Suggestions are made concerning possible electronic mechanisms giving rise to some of the above bands on the basis of the temperature dependence of their intensities and their types of afterglow.

535.376

2224. SOME SCINTILLATION CHARACTERISTICS OF DIAMOND UNDER ALPHA PARTICLE BOMBARDMENT.

J.E.Ralph.
Proc. Phys. Soc., Vol. 73, Pt 2, 233-8 (Feb., 1959).

Scintillation pulse-height spectra were examined for thirty-five natural diamonds under alpha-particle bombardment, and the mean pulse heights V_0 and dispersion η were found to be largely uncorrelated with the type I and type II classification. After-pulses of about 0 msec duration were observed for all specimens and their variation with particle energy was investigated.

535.376

2225. DECAY AND MECHANISM OF THE LUMINESCENCE OF GASES EXCITED BY FAST ELECTRONS.

K.Schmidt.
Z. Naturforsch., Vol. 11a, No. 12, 1023-30 (1956). In German.

Luminescence spectra and decay times were determined for gases excited by 50 kV electrons at pressures up to near atmospheric. Dependence of decay constant on gas pressure showed the quenching of luminescence to be due to collisions of the second kind in CO_2, O_2, and in N_2 mixed with H_2, O_2 or CO_2. The more complex processes occurring in N_2, H_2, Ne and Xe were identified by experiments on gas mixtures. Thus N_2 in He is excited by metastable He atoms, but in Ne by highly excited Ne atoms. For Ne in He a combination of processes is deduced.
S.T.Henderson

535.376

2226. TWO METHODS FOR THE INVESTIGATION OF FLUORESCENCE DECAY PROCESSES.

F.Gläser.
Z. Naturforsch., Vol. 11a, No. 12, 1030-6 (1956). In German.

Decay constants of 10^{-9} sec can be measured. With cathode-ray excitation the decay curve is traced either point by point, or continuously on an expanded time scale. With excitation by fast particles or high energy quanta, the decay constant is obtained from measurements of the amplitude spectrum of the decay curve.
J.Franks

535.376 : 539.1.07

2227. CAESIUM IODIDE AS SCINTILLATION PHOSPHOR.

H.Knoepfel, E.Loepfe and P.Stoll.
Z. Naturforsch., Vol. 12a, No. 4, 348-50 (1957). In German.

In compressed powder form, CsI can give impulses from α-particles as high as those from a single crystal of the same size. The blue emission increases rapidly as temperature is lowered from -100° to -180°C, and among very different samples the best was one crystallized from water. The time constant remains at ~0.5 μsec throughout. With Tl activator the time constant increases from 1 μsec at -80°C to 12 μsec at -125°C, while the emission is now yellow under electrons or protons and decreases with cooling. Both emission processes are observed in pure CsI which has been heated to 800-900°C or exposed to Na vapour at 610°C. (See Abstr. 9736/1957).
S.T.Henderson

535.376 : 533.6.011 : 533.12

ELECTRON BEAM FLUORESCENCE PROBE FOR MEASURING GAS DENSITY. See Abstr. 2141

535.376

2228. ELECTROLUMINESCENCE OF CdS—Ag WITH AN Ag_2S LAYER.

H.Łożykowski and H.Męczyńska.
Bull. Acad. Polon. Sci. Ser. Sci. math. astron. phys., Vol. 6, No. 9, 595-8 (1958).

Presence of a Ag_2S layer on CdS—Ag enhances electroluminescence. Optical excitation of luminescence was also carried out the phosphors covered with Ag_2S showing shorter decay times than uncovered specimens.
G.F.J.Garlick

535.376 : 537.311.33

2229. IMPURITY BANDS AND ELECTROLUMINESCENCE IN SiC P—N JUNCTIONS.

L.Patrick and W.J.Choyke.
J. appl. Phys., Vol. 30, No. 2, 236-48 (Feb., 1959).

A study of the electroluminescence of certain SiC p—n junctions, between 77°K and 830°K, and over a range of 10^4 in current density, has been used to verify and to extend a 3-part model (P—N*—N) of the junctions derived from electrical measurements. The electroluminescence, due to recombination in N*, consists of two parts, which may be called impurity luminescence and intrinsic recombination radiation. At low temperatures (≤ 200°K) only the former is present. Several effects of impurity banding on the electroluminescence can be predicted, and some of these have now been observed. The most striking of these effects is the "Fermi-level emission edge' in the low-temperature spectra, an edge which moves to higher energies with increasing current density because of the impurity band injection of electrons. The predominance of impurity band injection at low temperatures excludes the possibility of intrinsic recombination radiation. At high temperatures, however, electron injection is by way of the conduction band. The intrinsic recombination radiation observed at higher temperatures has been compared with that calculated from earlier absorption data, using the theory of van Roosbroeck and Shockley. From the comparison, the density of electrons in the conduction band, and the electron lifetime (10^{-8} sec) at room temperature are obtained. This lifetime is very short compared with the measured hole lifetime, and is possibly a result of the merging of impurity band and conduction band levels. This junction model is now detailed enough to estimate impurity level densities and the hole and electron densities. From these, one is able to calculate cross-sections for the various recombination processes involved. All luminescent processes have been found to have a recombination cross-section of approximately 10^{-23} cm^2.

535.376

2230. EFFECTS OF IMPURITIES AND TEMPERATURE ON THE SPECTRA OF ELECTROLUMINESCENCE. R.Huzimura and T.Sidei.

J. Phys. Soc. Japan, Vol. 13, No. 9, 1064-5 (Sept., 1958).

Electroluminescent ZnS:Cu has blue, green and yellow emission bands, the second being the largest except at low temperatures, when the blue band predominates. A hexagonal sample also showed mainly blue emission. Increased content of Pb intensifies the total emission roughly proportionately within the range studied. S.T.Henderson

535.379

2231. THE EMISSION OF ACTIVATED ALKALINE EARTH META-ANTIMONATES. H.Witzmann and H.Köhler.

Naturwissenschaften, Vol. 45, No. 19, 462 (1958). In German.

Luminescence emission is obtained from $Ca(SbO_3)_2$ activated with Mn, Bi or Pb, $Sr(SbO_3)_2$:Bi has a strong green emission, $Sr(SbO_3)_2$:Pb emits weakly in the near ultraviolet, $Ba(SbO_3)_2$:Bi or $Ba(SbO_3)_2$:Pb has a weak emission. J.Franks

535.379

2232. ON SONOLUMINESCENCE.

P.Günther, W.Zeil, U.Grisar, W.Langmann and E.Heim.

Z. Naturforsch., Vol. 11a, No. 10, 882-3 (1956). In German.

A study is made of the emission from solutions with rare gases dissolved, and with and without electrolyte present. Addition of electrolytes (e.g. NaCl) enhances the sonoluminescence which, in addition to a continuum, contains characteristic spectral lines for the alkali and alkaline earth elements in solution. The characteristic emission is suppressed by addition of radioactive isotopes. Dependence of the emission on temperature is also investigated. G.F.J.Garlick

535.379

2233. PHASE CORRELATION OF SOUND PRESSURE AND SONOLUMINESCENCE. W.U.Wagner.

Z. angew. Phys., Vol. 10, No. 10, 445-52 (Oct., 1958). In German.

The luminescence occurs at the minimum sound pressure, which suggests that the hypothesis that it is caused by adiabatic heating gas bubbles is incorrect. The experimental arrangement used is described. J.M.Hough

535.39

2234. REFLECTION METHOD FOR THE DETERMINATION OF THE OPTICAL CONSTANTS IN THE INFRARED OF VERY ABSORBING SOLIDS. J.Vincent-Geisse, M.Queyrel and J.Lecomte.

C.R. Acad. Sci. (Paris), Vol. 247, No. 17, 1330-2 (Oct. 27, 1958). In French.

The reflection coefficient is measured at normal incidence for the substance alone and for the substance covered with a thin dielectric layer, whose optical constants in the infrared are known. The results for calcite and quartz in the range 1000 to 1700 cm^{-1} agree with data obtained by other methods. B.T.M.Willis

535.39.07

2235. SIMPLE WIDE RANGE SPECULAR REFLECTOMETER. R.F.Weeks.

J. Opt. Soc. Amer., Vol. 48, No. 11, 775-7 (Nov., 1958).

A wide range absolute specular reflectometer of simple design was built to measure the absolute reflectivity of single crystals at liquid-nitrogen temperature. The basic design, theory of operation, and inherent limitations of the design are discussed in terms of the spectral and temperature regions attainable.

535.392

2236. ON THE VALIDITY OF THE KUBELKA—MUNK FUNCTION FOR REFLECTION SPECTRA OF POWDERS.

G.Kortüm and G.Schreyer.

Z. Naturforsch., Vol. 11a, No. 12, 1018-22 (1956). In German.

Measurements on strongly absorbing material (powdered didymium glass) show that the function is not valid for either diffuse or directed incident light. It does hold, however, when the material is diluted with non-absorbing material (MgO). This is also confirmed with powdered MgO—K_2CrO_4, and the agreement is better for reflections integrated over a whole absorption band than for measurements at a single wavelength. G.F.Lothian

535.399 : 539.2

2237. CALCULATION OF ABSORPTION PEAKS IN THIN METAL FILMS. R.M.Hill.

Nature (London), Vol. 182, 1150-1 (Oct. 25, 1958).

Attention is drawn to the well-known difference between absorption and extinction coefficients respectively as relating to the optica constants of metals. Data purporting to correlate a function of the optical constants with the presence or absence of an absorption band are recalculated on a basis free from a confusion of the two coefficients, and shown to disagree with experimental fact. The author's own experiments on Cr films have failed to support Maxwell—Garnett's theory of aggregation. R.A.Weale

535.399 : 537.311.33

2238. THE OPTICAL PROPERTIES OF BISMUTH TELLURIDE. I.G.Austin.

Proc. Phys. Soc., Vol. 72, Pt 4, 545-52 (Oct., 1958).

The shape of the absorption edge in the semiconductor Bi_2Te_3 was determined from transmission measurements on cleavage sections. The edge is of the form expected for indirect transitions, but an interpretation in terms of phonons characterized by a single energy is not applicable. A brief study of anisotropy effects is included. The energy gap at room temperature is close to 0.13 eV with a temperature coefficient of -0.95×10^{-4} eV deg^{-1}. The refractive index, determined from interference fringes, is 9.2 in the region 8-14 μ. In degenerate samples the absorption edge is displaced towards higher energies. A simple quantitative discussio of this effect is given.

535.399 : 537.226.2 : 548.736.

2239. SOME PROPERTIES OF MAGNESIUM FLUORIDE CRYSTALLIZED FROM THE MELT.

A.Duncanson and R.W.H.Stevenson.

Proc. Phys. Soc., Vol. 72, Pt 6, 1001-6 (Dec., 1958).

Magnesium fluoride crystals can be grown in vacuo using the Stockbarger technique. The melting point is 1255 ± 3°C. The crystal structure is of the tetragonal SnO_2 type, with lattice constant $a = 4.621 \pm 0.001$ A and axial ratio $1 : 0.6601 \pm 0.0001$ giving $c = 3.050$ A at 18°C. The density is 3.1766 ± 0.0002 g cm^{-3} at 18°C MgF_2 is a uniaxial positive crystal, and the refractive indices are given for the ordinary and extraordinary rays at various wavelength in the visible spectrum. The transparent region extends from 1100 A to 1360 cm^{-1}. Infrared reflectivity begins to rise at about 620 cm^{-1}, and peaks around 500 cm^{-1}. The mean dielectric constan is $\epsilon_m = 5.26$.

535.39

2240. COMPLETE ABSORPTION OF LIGHT BY THIN METAL FILMS. T.Turbadar.

Proc. Phys. Soc., Vol. 73, Pt 1, 40-4 (Jan., 1959).

Reflectances of non-opaque aluminium films were measured from the substrate side as a function of angle of incidence. For the p-polarization there is a maximum reflectance near the critical angle for the substrate; for a certain range of Al thicknesses this is followed by a sudden drop which can be to zero reflectance giving complete absorption. This effect can be predicted from thin film theory but has not previously been noted.

535.399 : 539.

2241. ON TAKING INTO ACCOUNT THE MUTUAL CORRELATION OF ELECTRONS IN METAL OPTICS. R.N.Gurzhi.

Zh. eksper. teor. Fiz., Vol. 35, No. 4(10), 965-9 (1958). In Russian

Absorption of infrared rays in metals is examined on basis of Landau's Fermi-fluid theory allowing for the quantum properties of the electromagnetic field.

535.399 : 539.

2242. THEORY OF THE OPTICAL PROPERTIES OF CONDUCTORS IN THE CASE OF OBLIQUE INCIDENCE OF RADIATION. V.P.Silin.

Zh. eksper. teor. Fiz., Vol. 35, No. 4(10), 1001-4 (1958). In Russia

A microscopic theory of the optical properties of conductors i presented for the case when the mean free path of electrons is not small compared with the characteristic distance of variation of the electromagnetic field. The difference from the ordinary optics of conductors is due allowance for the surface current which results from scattering of electrons on the surface of the sample. Inciden of the radiation at an arbitrary angle to the surface of a massive conductor is considered. It is shown that the effective complex refraction indexes depend on the angle of incidence and also differ fr each other for different polarizations of the radiation. Within one order of magnitude this difference equals the ratio of the electron velocity to the velocity of light.

535.412

2243. TWO-BEAM INTERFERENCE FRINGES AND INFORMATION THEORY. P.M.Duffieux.
Rev. Opt., Vol. 37, No. 9, 441-57 (Sept., 1958). In French.

A general study of fringe formation in terms of the geometry of the interferometer. The fringe visibility throughout the region of fringes gives information about the geometry and spectral composition of the source. Thus information can be transmitted from the object side to the image side of the instrument either directly as an image or indirectly as a system of fringes. In both cases the information-carrying capacity is limited by the spatial frequency transmission of the apertures producing the interfering beams but in the second case this limitation applies only to information about the shape of the source. The causes of fringe localization are examined and it is concluded that no clear distinction can be drawn between localized and non-localized fringes. W.T.Welford

535.417

2244. AN ELEMENTARY INTRODUCTION TO THE USE OF THE GRATING INTERFEROMETER. V.Ronchi.
Atti Fond. Ronchi, Vol. 13, No. 5, 368-403 (Sept.-Oct., 1958).

The elementary theory of the grating interferometer is presented for the benefit of those who want to apply the Ronchi test in practice, without being concerned with the intricacies of the exact theory.

535.42 : 534.321.9

2245. DIFFRACTION OF LIGHT BY A PROGRESSIVE ULTRASONIC WAVE. CALCULATION OF THE INTENSITY OF THE RAYS. N.Segard, J.Pouliquen and E.Deffontaines.
Ann. Soc. Sci. Bruxelles, Vol. 70, No. 3, 223-31 (1956). In French.

A theoretical calculation of the ray track in a liquid modulated by a plane ultrasonic wave. J.M.Hough

535.42 : 534.321.9

2246. STUDY OF THE INTENSITY DISTRIBUTION OF THE LIGHT DIFFRACTED BY ULTRASONIC WAVES.
R.B.Miller and E.A.Hiedemann.
J. Acoust. Soc. Amer., Vol. 30, No. 11, 1042-6 (Nov., 1958).

Detailed measurements of the light intensity of the diffraction orders produced by progressive ultrasonic waves in xylene were made. These were compared to the Raman—Nath theory, and to a modification of this theory by Mertens. Although it was found that in some cases Mertens' modifications were significant, there remain deviations between theory and experimental results which suggest that the actual experimental conditions deviate from the usual theoretical assumptions.

535.42

2247. ATTEMPT TO INVESTIGATE EXPERIMENTALLY THE INTENSITY DISTRIBUTION NEAR THE FOCUS IN THE ERROR-FREE DIFFRACTION PATTERNS OF CIRCULAR AND ANNULAR APERTURES. C.A.Taylor and B.J.Thompson.
J. Opt. Soc. Amer., Vol. 48, No. 11, 844-50 (Nov., 1958).

The intensity distribution is investigated experimentally using an optical diffractometer, and the positions of the axial minima on either side of the geometrical focus are measured. The results are compared with the predicted theoretical distributions in various planes perpendicular to the optical axis.

535.43 : 538.566

VARIATIONAL PRINCIPLES IN HIGH-FREQUENCY SCATTERING. See Abstr. 1613

535.435

2248. [CONTRIBUTION] TO THE THEORY OF RAYLEIGH SCATTERING OF LIGHT IN LIQUIDS. V.L.Ginzburg.
Zh. eksper. teor. Fiz., Vol. 34, No. 1, 246-7 (1958). In Russian.

The author argues that the scattering of light may be due to processes different from the fluctuations of the state of strain or of temperature. Fluctuations of the orientation of anisotropic molecules is an example of an alternative phenomenon giving rise to scattering of light. The current interpretation of scattering is critically discussed. R.Eisenschitz

535.514.4

2249. SURFACE POLARIZERS FOR THE NEAR INFRA-RED. L.Drechsel.
Naturwissenschaften, Vol. 44, No. 20, 533 (1957). In German.

The spectral transmission of dichroic coloured polyvinyl alcohol foils which have been suitably oriented and dried is shown graphically. They serve as polarizers between 0.6 and 2.8μ and between 315 and 6.5μ. S.Weintroub

535.55

2250. DISPERSION OF THE STRESS OPTICAL COEFFICIENT OF THE ALKALI HALIDES. R.Srinivasan.
Nature (London), Vol. 182, 1660-1 (Dec. 13, 1958).

Results for KBr, KCl and NaCl are given for the wavelength range 0.24 μ to 0.5 μ. W.T.Welford

535.563 : 535.32

2251. GENERALIZATION OF THE FORMULA OF H.BECQUEREL. APPLICATION TO MONATOMIC GASES. R.de Mallemann.
C.R. Acad. Sci. (Paris), Vol. 247, No. 6, 613-17 (Aug. 11, 1958). In French.

The formula of Becquerel relating the Verdet constant to the dispersion of the refractive index is exact only when the polarization is due to electron displacement. This is approximately true only for a certain frequency range. By considering the relationship between magnetic rotary power and the refractivity a more general equation is deduced for a monatomic substance. This equation is applied to the case of a monatomic gas, in which case there is no frequency restriction and the effects of polarization due to the displacement of the nuclei are included. The theory is supported by the experimental work of Ingersoll (Abstr. 6552/1956). H.G.Jerrard

535.7

PHYSIOLOGICAL OPTICS. VISION. See also the Section entitled "BIOPHYSICS. PHYSIOLOGICAL PHYSICS".

535.81 : 539.1.07

2252. TRANSMISSION CHARACTERISTICS OF LIGHT PIPERS. C.C.Harris and P.R.Bell.
I.R.E. Trans Nuclear Sci., Vol. NS-3, No. 4, 87-9 (Nov., 1956).

Discusses several of the important factors involved in the transmission of light through guides. The superiority of specular reflectors as compared with diffuse reflectors, the superiority of dry reflectors as compared with optically coupled reflectors, and the importance of surface polish are discussed. The use of total-internal-reflection couplers between scintillation crystal and light guide is described. Relative pulse heights obtained with certain crystal—guide—reflector combinations are given, and transmissions as functions of guide length and configuration are shown.

535.81 : 536.521

LIGHT GUIDE RADIATION PYROMETRY. See Abstr. 1385

535.81 : 536.521

MORE ACCURATE ADJUSTMENT OF FILAMENT PYROMETERS BY MEANS OF CONTRASTING PLATES. See Abstr. 1386

535.822.1

2253. A "SOLID-IMAGE" MICROSCOPE.
R.L.Gregory and P.E.K.Donaldson.
Nature (London), Vol. 182, 1434 (Nov. 22, 1958).

The limited depth of focus of a conventional microscope is a great handicap in many biological applications. A solid image can be built up by scanning the object in depth. The object is mounted on a tuning fork and the screen upon which the image is projected is attached to a second fork vibrating at the same rate and in phase with the first. Although the image possesses defects, the system shows promise and is bring modified for improved performance. R.W.Fish

535.822.1 : 539.1.07

MICROSCOPE FOR ANALYSIS OF LARGE NUCLEAR PLATES. See Abstr. 1643

535.822.6

2254. DIFFRACTION ANOMALY IN POLARIZING MICROSCOPES. S.Inoué and H.Kubota.
Nature (London), Vol. 182, 1725-6 (Dec. 20, 1958).

A polarizing microscope with crossed polarizers does not give a completely dark field, due to rotation of the plane of polarization on oblique incidence at lens surfaces. The diffraction image of a point source under these conditions is a clover-leaf pattern with maxima at the position of the first minimum of the normal Airy disk pattern. This can introduce spurious structure in the image, but the effect can be practically eliminated by using a "polarization rectifier". H.Mykura

535.88 : 621.397.3

2255. NEW COLOR PROJECTION SYSTEM. W.E.Glenn.
J. Opt. Soc. Amer., Vol. 48, No. 11, 841-3 (Nov., 1958).

An optical system has been devised for projecting images in colour. The colour is selected by the spacing of diffraction gratings in each picture element and their amplitude determines the intensity of the element. The gratings can be formed either by a photographic process or by an electron beam in a simultaneous colour television projection system. An improved primary colour system is presented for use with this projector.

535.892

2256. ILLUMINATION OF SQUARE SURFACES BY LINE SOURCES. G.Franke.
Optik, Vol. 15, No. 8, 457-9 (Aug., 1958). In German.

A square area may be illuminated from a slit by interposing a raster of cylindrical lenses. Uniformity of illumination can be obtained either by continuous movement of the source or by an appropriate lens system. J.W.T.Walsh

HEAT

536.2

2257. PROPAGATION OF A PROGRESSIVE [AVTOMODEL'NAYA] THERMAL WAVE. É.I.Andriankin.
Zh. eksper. teor. Fiz., Vol. 35, No. 2(8), 428-32 (1958). In Russian.

Propagation of a thermal wave from a point source in a gas is studied taking account of the dependence of internal energy of the gas on temperature. The case when internal energy belongs not only to the matter but also to the radiation is considered. The radiation range is assumed to depend on the temperature in accord with a power law. The approximate method can also be applied in the case of an arbitrary dependence of the internal energy and heat flux on temperature.

536.2.083

2258. A METHOD FOR THE DETERMINATION OF THE THERMAL CONDUCTIVITY OF THIN PROBES AT HIGH TEMPERATURES. F.P.Pott.
Z. Naturforsch., Vol. 13a, No. 2, 116-25 (Feb., 1958). In German.

Mainly theoretical. The method is similar to that of Kohlrausch, but takes into account the simultaneous thermal leakage (in accordance with Newton's law) from the surface of the thin metal strip. Two separate determinations are required in order to obtain both the thermal conductivity and the leakage-constant. Expressions for the various corrections to be applied for parasitic thermal e.m.f.'s, asymmetric temperature distribution, etc., are derived. The suitability of the method is illustrated by reference to results on copper. S.Weintroub

536.212 : 537.323

2259. THERMAL CONDUCTIVITY AND THERMOELECTRIC POWER OF GERMANIUM—SILICON ALLOYS.
M.C.Steele and F.D.Rosi.
J. appl. Phys., Vol. 29, No. 11, 1517-20 (Nov., 1958).

Thermal conductivity measurements were made on a series of germanium—silicon alloys. At $300^\circ K$ for an alloy containing 56 atomic per cent Si, the thermal conductivity was found to be six times smaller than the value for pure Ge. Measurements of the thermoelectric power on some alloys are also reported. It is then shown that solid-solution alloying can significantly increase the figure of merit of thermoelectric materials.

536.212

2260. ON THE ANISOTROPIC THERMAL CONDUCTIVITY OF TETRAGONAL $BaTiO_3$. E.Snitzer and C.R.Mingins.
J. chem. Phys., Vol. 29, No. 5, 1187-8 (Nov., 1958).

Qualitative theoretical considerations show that a large anisotropy in the thermal conductivity can be caused by an anisotropy in the relaxation time, even though there is only a small anisotropy in the phonon frequency distribution. Preliminary experiments show a higher conductivity parallel to the c-axis than perpendicular to it. J.Hawgood

536.212

2261. THERMAL CONDUCTIVITY OF MnO AND NiO.
G.A.Slack and R.Newman.
Phys. Rev. Letters, Vol. 1, No. 10, 359-60 (Nov. 15, 1958).

Reports measurements of the thermal conductivities of single crystals of MnO and NiO in the temperature range $3-300^\circ K$. For MnO there is a minimum in the thermal-conductivity/temperature curve at the Néel temperature ($120^\circ K$). The results are discussed in terms of umklapp and boundary scattering. A.E.De Barr

536.212.2 : 539.219

2262. ON THE THERMAL CONDUCTIVITY OF DISORDERED DIELECTRIC ALLOYS. J.Tavernier.
C.R. Acad. Sci. (Paris), Vol. 247, No. 16, 1179-81 (Oct. 20, 1958). In French.

By combining a Peierls-type phonon—phonon scattering theory with the mass fluctuation theory it is possible to predict qualitatively the experimental dependence of thermal conductivity on temperature and on the crystal disorder parameter. J.Hawgood

536.212.2

2263. A NEW APPARATUS FOR THE MEASUREMENT OF THE THERMAL CONDUCTIVITY OF METALS. K.H.Bode and W.Fritz.
Z. angew. Phys., Vol. 10, No. 10, 470-9 (Oct., 1958). In German.

This precision method for measurements between 20° and $100^\circ C$ employs metal cylinders of 50 mm diameter and 70 mm height. The heater covers one of the end faces. Its design is such as to ensure uniform temperature distribution. The opposite end of the cylinder rests on a water cooled metal block. The whole is immersed in a box with heated end rings. The thermal conductivity of aluminium (99.99% and 99.5% purity), various non-ferrous and ferrous alloys and cast iron have been measured. The apparatus is intended for the standardization of testpieces with which other apparatus can be calibrated. R.Schnurmann

536.23 : 537.56

2264. THERMAL CONDUCTIVITY OF AN ELECTRON GAS IN A GASEOUS PLASMA. T.Sekiguchi and R.C.Herndon.
Phys. Rev., Vol. 112, No. 1, 1-10 (Oct. 1, 1958).

The thermal conductivity of an electron gas in a gaseous plasma is determined by experimental techniques which have been improved over those reported by Goldstein and Sekiguchi (Abstr. 2369/1958). A pulsed microwave is utilized to probe the plasma parameters as well as to selectively heat up the electron gas in a small volume of the elongated plasma. The photomultiplier tube detects the change in electron temperature by taking advantage of the phenomenon of "afterglow quenching". The experimental values for the thermal conductivity, which are determined by two different methods, are in good agreement. In the plasmas investigated, neon and helium, the degree of ionization is very low (10^{-5}-10^{-6}). However, the measured values of the thermal conductivity are still consistent with those obtained from the theoretical expression given by Landshoff, or Spitzer and Härm for a fully ionized gas.

536.23.08 : 536.33.08

EFFICIENCY OF THE BISMUTH BOLOMETER.
See Abstr. 1371

536.413.3 : 538.221

2265. X-RAY CRYSTALLOGRAPHIC INVESTIGATION OF THE THERMAL EXPANSION COEFFICIENT OF THE ANTIFERROMAGNETIC COMPOUND MnTe. N.P.Grazhdankina and D.I.Gurfel'.
Zh. eksper. teor. Fiz., Vol. 35, No. 4(10), 907-10 (1958). In Russian.

The variation of the crystal lattice parameters of manganese telluride (MnTe) in the vicinity of the antiferromagnetic transformation point was investigated using X-ray diffraction techniques. A suggestion concerning the magnetic structure of MnTe is made on basis of the data obtained. The Néel point temperature, $T = 310^\circ K$ was determined from the anomalous variation of the thermal expansion coefficient and an estimate of the dependence of T on omnidirectional pressure was made.

536.421.4

2266. FREEZING OF LIQUIDS IN POROUS MEDIA WITH SPECIAL REFERENCE TO FROST HEAVE IN SOILS.
K.A.Jackson and B.Chalmers.
J. appl. Phys., Vol. 29, No. 8, 1178-81 (Aug., 1958).

If the surface area of a liquid is large compared to its volume, the normal freezing temperature of the liquid will be altered. In a porous material a liquid can therefore exist in equilibrium, below its normal freezing temperature. However, such a liquid will be unstable with respect to bulk solid. This instability provides the driving force for frost heave in soils.

536.422 : 537.529

2267. ELECTRICAL EXPLOSION OF SPIRAL WIRES IN VACUUM
I.F.Kvartskhava, V.V.Bondarenko, R.D.Meladze and K.V.Suladze.
Zh. eksper. teor. Fiz., Vol. 35, No. 4(10), 911-16 (1958). In Russian

During explosion of bent wires in vacuum, besides the appearance of current tubes due to the motion of the explosion products through the magnetic field of the current, some glow effects were also detected which are due to the interaction of the beams of the explosion products. The value of the velocity of the beam front has been found to equal 10^6 cm/sec by scanning the explosion with a mirror. The possibility of thermal insulation of the plasma with aid of a strong magnetic field which exists during a very short period o time during the explosion is demonstrated. A qualitative explanatio of the observed effects is given.

536.424.1 : 537.226.2

PHASE TRANSITIONS IN SOLID SOLUTIONS FORMED IN THE SYSTEMS $(Ca,Sr)(Ti,Zr)O_3$ AND $Na(Nb,Ta)O_3$. See Abstr. 1418

536.48

2268. PHYSICAL INVESTIGATIONS AT VERY LOW TEMPERATURES. W.Buckel.

Naturwissenschaften, Vol. 45, No. 18, 431-4 (1958). In German.

Review article. The lowest temperatures obtainable are related to the interaction energy of the cooling process. For paramagnetic salts this energy is $\sim 10^{-2}$ °K and for nuclear paramagnetism 10^{-5} to 10^{-6} °K. Using the latter effect extreme thermal insulation (heat influx < 10 erg/sec) is required and a starting temperature of 10^{-2} °K is needed for the orientation of the nuclei in available magnetic fields. The difficult heat transfer at 10^{-2} °K between the nuclear spin and the rest of the system requires the use of metals for the nuclear stage, as only with free electrons is the heat transfer sufficiently rapid. Phenomena that can be investigated at the very low temperatures include the very interactions that set the limit to the obtainable temperature, further those that require a partial orientation of the nucleus like experiments on the non-conservation of parity and other directional effects in radioactivity, finally electrical conductivity and caloric properties of liquid helium. H.London

536.48 : 536.21

2269. THE THERMAL CONDUCTIVITY OF CONDENSED HELIUM. J.Wilks.

Nuovo Cimento Suppl., Vol. 9, No. 1, 84-94 (1958).

Review of experimental results and discussion. (1) Solid He. The thermal conductivity (K) is controlled by the umklapp process, which leads first to an increase of K with falling temperature and with rising pressure (i.e. density, Debye temperature), until the scattering mean free path of the phonons approaches the dimensions of the specimen or its crystal boundaries, and then to a decrease with falling temperature and decreasing dimensions. A decrease of K in isotropic mixtures due to scattering of the phonons on randomly distributed constituents is postulated. (2) Liquid He I. The only data available are along the saturated vapour pressure curve. Here K rises with temperature. By analogy with liquid argon, it is expected that at low constant density the conductivity rises with temperature (gas-like behaviour), and at high density it rises with falling temperature (solid-like behaviour). (3) Liquid He II. Below 0.6°K the behaviour resembles the solid in the long mean free path region. Above 0.6°K there is a complex behaviour due to thermal waves and two-fluid heat transport. The steady heat flow is radically suppressed by small additions of He^3, which not only suppresses the two-fluid heat transport but also affects the phonon conduction below 0.6°K in the same way as has been postulated under (1). (4) Pure He^3, which has been investigated under its own vapour pressure behaves similarly to He I. Owing to the larger atomic volume, the absolute value of the K is still closer to that of the gas. H.London

536.48

2270. LIQUID HELIUM AS A QUANTUM LIQUID. J.de Boer.

Nuovo Cimento Suppl., Vol. 9, No. 1, 199-227 (1958).

Review paper. The principle of corresponding states is extended by the introduction of a new dimensionless parameter $\lambda^* = h/(m\epsilon)^{1/2}\sigma$, where ϵ and σ are defined by the 12—6 potential

$$\varphi(r) = 4\epsilon[(\sigma/r)^{12} - (\sigma/r)^{6}],$$

on which the calculations are based. This allows the formulation of an universal equation of state which takes account of quantum effects. On this basis the ground state of liquid and solid helium is discussed in detail. Next thermal excitations are considered. These are divided into collective excitations (phonons) and molecular excitations (rotons). On the basis of their distribution functions expressions are derived for the thermodynamic functions and for the two-fluid hydrodynamics. Finally, a theoretical description of the two types of excitations is given on the basis of a generalized cell model. H.London

536.48

2271. THE EQUILIBRIUM PHASE TRANSITION IN LIQUID HELIUM. E.Mayer.

Nuovo Cimento Suppl., Vol. 9, No. 1, 234 (1958).

In collaboration with Aroeste and Baldursson an investigation was attempted of the properties of a Bose—Einstein liquid. The essential feature of the treatment is to express the properties of the Bose—Einstein liquid in terms of those of an hypothetical Boltzmann liquid for which the density matrix has not been symmetrized. The pair and higher distribution functions of the Boltzmann liquid enter the equations. The X-ray diffraction pattern of He I is used to obtain the necessary function for two atoms, and the Kirkwood closure assumed for the higher functions. The parameters necessary to reproduce some of the features observed in the transitions are all reasonable.

536.48 : 532.5 : 530.145

2272. QUANTUM HYDRODYNAMICS AND THE THEORY OF HELIUM II. A.Thellung.

Nuovo Cimento Suppl., Vol. 9, No. 1, 243-55 (1958).

Helium is regarded as a perfect liquid. The equations of classical hydrodynamics (omitting dissipative terms) are transformed to a Hamiltonian formalism and quantized by standard methods. Hence the energy spectrum can be arrived at. An account of the present state of this theory is given and possible developments are discussed. R.Eisenschitz

536.48

2273. ON THE STRUCTURE OF LIQUID ^{4}He. S.Franchetti.

Nuovo Cimento Suppl., Vol. 9, No. 1, 286-90 (1958).

A lattice model for liquid helium is elaborated. Wave-functions for a particle localized in the neighbourhood of a lattice point are combined so that they form a single-particle wave-function that is extended over the whole volume. Hence a multi-particle wave function is derived which has the correct symmetry relative to permutations. From this wave-function the radial distribution function is derived and compared with the distribution as obtained from X-ray or neutron diffraction. It is found that agreement is fair if the lattice is assumed to have a cubic face centred structure. For distances of less than 3 A, it is necessary to take account of the effect of binary collisions. R.Eisenschitz

536.48

2274. SOME COMMENTS ON THE THEORY OF LIQUID ^{3}He. M.J.Buckingham.

Nuovo Cimento Suppl., Vol. 9, No. 1, 306-9 (1958).

The author discusses the value of the quantity

$$R = (\chi_f/\chi_c)/(C_V/Nk),$$

where χ_f and χ_c are the magnetic susceptibilities of a fermion and a classical gas and C_V is the low-temperature specific heat of a fermion gas. For perfect gases $R = 3/\pi^2$. If there is a spin dependent exchange energy between the fermions, R will depend on an energy parameter which varies sensitively with the density. On account of the exchange energy the experimental value of R for liquid He^3 is six times larger than for a perfect gas. R.Eisenschitz

536.48

2275. SOME PROPERTIES OF LIQUID ^{3}He. B.Weinstock, B.M.Abraham and D.W.Osborne.

Nuovo Cimento Suppl., Vol. 9, No. 1, 310-19 (1958).

After a general review of the subject, the interpretation of the entropy of He^3 is discussed in some detail. The experimental entropy above 1.4°K is a linear function of the temperature. It is extrapolated to absolute zero and considered to be the contribution of the translational movement of the atoms. The difference of the experimental and the extrapolated entropy below 1.4° is assumed to be due to the antiferromagnetic ordering of the nuclear spins. This interpretation is supported by the direct measurements of the magnetic susceptibility. R.Eisenschitz

536.48

2276. SOME EXPERIMENTS WITH ^{3}He—^{4}He MIXTURES. K.W.Taconis and D.H.N.Wansink.

Nuovo Cimento Suppl., Vol. 9, No. 1, 320-4 (1958).

The authors' apparatus is equipped with two chambers which are connected by a narrow capillary. One chamber is filled with the mixture and the other is filled with pure liquid He^4. By heating the latter a fountain pressure is produced; it is either balanced by the osmotic pressure of the mixture or it has the effect of removing all He^4 from the mixture which will partially or fully evaporate. With this apparatus, the distribution of He^3 between the liquid and the vapour phase is determined and the osmotic pressure of the mixtures is measured. By thermodynamic deduction the specific heat of the mixtures is obtained. Agreement with the results obtained by other authors is satisfactory. R.Eisenschitz

536.48 : 539.12

2277. EXCITATION OF ROTONS IN HELIUM II BY COLD NEUTRONS. H.Palevsky, K.Otnes and K.E.Larsson.

Phys. Rev., Vol. 112, No. 1, 11-18 (Oct. 1, 1958).

The nature of collective excitations was investigated by means of the interaction of these excitations with cold neutrons. The experiment demonstrates the existence of excitations with long mean free path compared to their wavelength, confirming the theoretical ideas of Landau and Feynman. The dispersion relation for the excitations in the energy region of the "roton minimum" is directly measured and gives the following Landau parameters: $\Delta = 8.1 \pm 0.4$ °K, $P_0/\hbar = 1.9 \pm 0.03$ A^{-1} and $\mu = 0.16 \pm 0.02\ m_{He}$.

536.48

2278. ANGULAR MOMENTUM OF LIQUID HELIUM.

R.H.Walmsley and C.T.Lane.
Phys. Rev., Vol. 112, No. 4, 1041-7 (Nov. 15, 1958).

The difference in the angular momentum of liquid helium between an initial state in equilibrium with a steadily rotating cylindrical container and a final state with the container at rest has been measured both in He I and He II. If this quantity is denoted by L and the corresponding value for solid-body rotation of the liquid by L_c, then $L/L_c = 1$ for all temperatures and speeds used in the He I phase. In the He II region, however, and for speeds less than about 1 rad/sec, L/L_c decreases monotonically from unity with decreasing initial angular velocity of the containing vessel apparently approaching the ratio ρ_n/ρ as the initial angular velocity approaches zero. The results are compared with the Onsager—Feynman vortex model for He II and it is argued that concordance only can be obtained provided macroscopic rotational states of long lifetime can be shown to exist in this theory.

536.48

2279. THERMAL EXCITATIONS IN LIQUID He^3. L.Goldstein.

Phys. Rev., Vol. 112, No. 5, 1465-82 (Dec., 1958).

Using recently obtained data on various thermal properties of liquid He^3, the constant-volume heat capacity of the saturated liquid is evaluated. This elementary heat capacity $C_V(T)$ was found to exhibit at least three inflection points over the temperature interval extending to the critical temperature. Of these, the one at the lowest temperature was shown to originate with the partial heat capacity of spin disorder. The inflection point at the approach of the critical temperature T_c is imposed by the thermodynamic result that $C_V(T)$ should reach its finite limit $C_V(T_c)$ from below with positively infinite first and second temperature derivatives. The laws governing the pressure dependence of the partial spin heat capacity over the liquid region of the He^3 phase diagram have been deduced. The remarkable pressure effects displayed by the spin system of liquid He^3 through its heat capacity may be expected to manifest themselves through the observable pressure dependence of the total liquid heat capacity at low enough temperatures where the spin heat capacity is dominant. A purely heuristic and indirect approach toward the problem of the existence of phonon type of partial excitations in liquid He^3 yields a negative answer, without, however, a definite exclusion of such symmetrical excitations in this antisymmetric liquid.

536.48

2280. THE POMERANCHUK EFFECT AND THE STATE DIAGRAM OF He^3—He^4 SOLUTIONS.

I.M Lifshits and D.G.Sanikidze.
Zh. eksper. teor. Fiz., Vol. 35, No. 4(10), 1020-6 (1958). In Russian.

The influence of the Pomeranchuk effect (Abstr. 9427/1951) on equilibrium of the liquid and solid phases of He^3—He^4 solutions is investigated thermodynamically.

536.48 : 530.162

THE COLLECTIVE PROPERTIES OF A BOSON SYSTEM. See Abstr.2105

536.48

2281. INFLUENCE OF ^3He ON SOME FLOW PROPERTIES OF HE II. J.G.Dash and R.D.Taylor.

Nuovo Cimento Suppl., Vol. 9, No. 1, 334-40 (1958).

Mixtures containing up to 11% He^3 were investigated at temperatures between 1.3 to 2.2°K by means of torsional pendulum methods. Hence the effect is obtained of the concentration of He^3 on the significant properties of superfluid mixtures, in particular the total density, the density of the normal component, the temperature of the λ-transition, the coefficient of viscosity and the critical velocity. Results are discussed in terms of the current theories.

R.Eisenschitz

536.48

2282. PHENOMENOLOGICAL THEORY OF SUPERFLUIDITY NEAR THE λ-POINT. L.P.Pitaevskiĭ.

Zh. eksper. teor. Fiz., Vol. 35, No. 2(8), 408-15 (1958). In Russian.

A complete set of phenomenological equations is derived which describes the behaviour of superfluid helium near the λ-point. The normal part of the liquid is described in the usual manner, whereas the "superfluid" part is described by an "effective wave-function".

536.48

2283. CALCULATION OF THE PHONON COMPONENT OF MUTUAL FRICTION IN SUPERFLUID HELIUM. L.P.Pitaevskiĭ.

Zh. eksper. teor. Fiz., Vol. 35, No. 5(11), 1271-5 (1958). In Russian.

The mutual friction in superfluid helium due to scattering of phonons on vortex lines is calculated. It is shown that at a temperature of the order of 0.5°K, the phonon component becomes comparable with the roton component.

536.483

2284. SIMPLE CONTINUOUS He^3 REFRIGERATION SYSTEM.

H.A.Reich and R.L.Garwin.
Rev. sci. Instrum., Vol. 30, No. 1, 7-9 (Jan., 1959).

A simple continuous He^3 refrigerator which uses a minimal amount of gas (80 cm^3 S.T.P.) has been built. Temperatures below 0.5°K may be attained for as long as He^4 remains in the cryostat. Commercial components are used throughout.

536.52 : 535.23.08

A PRECISION, DIRECT-READING, COLOUR TEMPERATURE METER. See Abstr. 2190

536.521

2285. ACCURACY OF OPTICAL PYROMETRY IN THE RANGE 800°C TO 4000°C. D.R.Lovejoy.

Canad. J. Phys., Vol. 36, No. 10, 1397-408 (Oct., 1958).

A pair of secondary standard tungsten strip lamps have had a luminance temperature—current calibration, in the range 800°C to 2200°C, at a number of national laboratories. An analysis of the calibration results confirms estimates of the accuracy of optical pyrometry in the range 800°C to 2200°C and supports the extension of these estimates to 4000°C. The standard deviation uncertainty of optical pyrometry is shown to be about 1 deg C at 800° C rising to 2 deg at 2200°C and 10 deg C at 4000°C, being about double this for the calibration of commercial pyrometers unless certain described precautions are taken. The reliability of the secondary standard lamps, when used under well-defined conditions, is confirmed and it is shown that they have a standard deviation calibration uncertainty of about 1 deg C for the vacuum-type lamps in the range 800°C to 1500°C and 2 deg C for the gas-filled lamps in the range 1500°C to 2200°C. Most of this uncertainty is due to primary standard optical pyrometer calibration errors. Attention is drawn to the fact that a carbon arc fulfills the requirements of a secondary luminance temperature standard at about 3514°C. Recent determinations of the gold point and the second radiation constant indicate that the 1948 International Temperature Scale is lower than the thermodynamic scale by an amount varying from 0.8 deg C at 800°C to 12 deg C at 4000°C. This is already greater than the calibration errors of optica pyrometry and, in view of the still greater accuracies presaged by photomultipliers, a revision of the International Temperature Scale is suggested.

536.631

2286. SPECIFIC HEAT OF LiF AND KI AT LOW TEMPERATURES. W.W.Scales.

Phys. Rev., Vol. 112, No. 1, 49-54 (Oct. 1, 1958).

The heat capacities were measured over the temperature range 2-7°K. An adiabatic calorimeter was employed making use of a mechanical contact "heat switch". A carbon resistor embedded directly in the specimen was used as thermometer. For LiF the heat capacity was found to be proportional to the cube of the temperature over the range of temperatures investigated, and the value of θ_0 was found to be 722°K. For KI variations from the T^3 dependence were found above 3°K. An extrapolation of a smooth curve through the data to zero degrees temperature indicates a value of $\theta_0 = 128°K$. These values of θ_0 are compared to values of θ_0 derived from elastic constants data.

536.633 : 538.222

2287. MAGNETIC AND THERMODYNAMIC PROPERTIES OF COPPER (II) ACETONYLACETONE. J.J.Fritz and R.G.Taylor.

J. Amer. Chem. Soc., Vol. 80, No. 17, 4484-7 (Sept. 5, 1958).

The magnetic and thermodynamic properties of the copper (II) chelate of acetonylacetone were measured from 1.0 to 20°K. There is a small but sharp maximum in the zero-field heat capacity at about 1.25°K, below which the specimen absorbs energy from an alternating magnetic field. The total magnetic entropy removed down to 1.0°K is only about 10% of the R ln 2 expected at high temperatures. Above 2°K, the magnetic susceptibility follows a Curie—Weiss law.

536.631 : 539.219

SPECIFIC HEAT OF SOLID SOLUTIONS. See Abstr. 1898

THERMODYNAMICS

536.7 : 530.162

288. THE STATISTICAL THERMODYNAMICS OF A ONE-IMENSIONAL MULTICOMPONENT ASSEMBLY.
.C.Longuet-Higgins.
uovo Cimento Suppl., Vol. 9, No. 1, 345-6 (1958).

536.71

289. THERMODYNAMIC FUNCTIONS OF CARBON TETRA-HLORIDE AND MONOCHLORIDE. J.S.Gordon.
. chem. Phys., Vol. 29, No. 4, 889-90 (Oct., 1958).

Data were calculated for the ideal gases CCl_4 at 298.16° to 000° K,and CCl at 298.16° to 6000° K. The CCl_4 data are in good greement with published values.

536.722

290. ENTHALPY AND HEAT CAPACITY FROM 0° TO 900°C OF HREE NICKEL-CHROMIUM-IRON ALLOYS OF DIFFERENT ARBON CONTENTS. T.B.Douglas and A.W.Harman.
. Res. Nat. Bur. Stand., Vol. 60, No. 6, 563-8 (June, 1958).

The enthalpy relative to 0°C of three aloys was measured at ine temperatures from 100° to 900°C by a precise "drop" method. he alloys contained approximately 76% of nickel, 15% of chromium, nd 8% of iron, with carbon contents of 0.02, 0.07, and 0.11%, espectively. The results are almost independent of the several variations in prior heat treatment investigated, and the heat-capacity—emperature curves of the three alloys are almost coincident, but here is a marked shift in each curve within the interval 500° to 00°C.

536.722

291. HEAT CONTENT OF ZIRCONIUM AND OF FIVE COM-OSITIONS OF ZIRCONIUM HYDRIDE FROM 0° TO 900°C.
.B.Douglas and A.C.Victor.
. Res. Nat. Bur. Stand., Vol. 61, No. 1, 13-23 (July, 1958).

Using a precise Bunsen ice calorimeter, a "silver core" furnace, nd a "drop" method, the heat content (enthalpy) of zirconium metal nd five samples of zirconium hydride (24 to 52 atomic percent ydrogen) was measured over the range 0 to 900°C. Thermal hysteresis of the hydrides was investigated in several cases, and corrections were applied for the impurities in the samples. At each temperature up to 550°C the heat contents of the hydrides relative to °C were found to vary linearly with composition, a fact in accord ith the phase diagram of the system. The effective heat capacity f each hydride sample reached its maximum value between 550° and 00°C, a behaviour that can be interpreted as due to the endothermic ormation of the high-temperature beta phase.

536.73

292. A FORMAL TREATMENT OF THE CONSEQUENCES OF HE SECOND LAW OF THERMODYNAMICS IN CARATHÉODORY'S ORMULATION. H.A.Buchdahl.
. Phys., Vol. 152, No. 4, 425-39 (1958).

The consequences of the Second Law, as enunciated in the rinciple of Carathéodory, are developed by means of a largely ormal argument. The need for the introduction of the Theorem f Carathéodory does not arise. One virtue of the method is the mmediacy with which it leads to the Principle of Increase of ntropy.

536.75 : 539.2

RESIDUAL ENTROPY OF ICE, AND RELATED COMBINATORIAL PROBLEMS. See Abstr. 1851

ELECTRICITY

537.21 : 538.3

ELECTRODIELECTRIC INDUCTION. See Abstr. 1594

537.221 : 534.4

SPONTANEOUS ELECTRIFICATION OF DUST FIGURES IN A UNDT'S TUBE. See Abstr. 2183

ELECTROSTATICS . DIELECTRICS

537.224 : 621.319.4

2293. DETERMINATION OF THE UNIT OF CAPACITANCE.
A.F.Dunn.
Canad. J. Phys., Vol. 37, No. 1, 35-46 (Jan., 1959).

As part of the programme to establish a wholly self-consistent group of basic electrical units for Canada, the unit of capacitance maintained in the National Research Council has been determined in an absolute sense in terms of the frequency and resistance units maintained in the laboratories, with an accuracy comparable to that of the primary standards. The determination was made by connecting additional components to an existing capacitance and conductance measuring bridge to form a modified Wien bridge network. The results obtained indicate an accuracy of ±0.0025%.

537.224 : 621.319.4

2294. ACCURATE DETERMINATION OF THE CAPACITANCE OF RECTANGULAR PARALLEL-PLATE CAPACITORS. D.K.Reitan.
J. appl. Phys., Vol. 30, No. 2, 172-6 (Feb., 1959).

The basic theory of calculation of the capacitance of a parallel-plate capacitor by the method of subareas is advanced. This method enables accurate approximation of the long-standing problem of the accurate evaluation of the capacitance of a rectangular parallel-plate capacitor. A universal curve enabling rapid determination of the capacitance of the commonly used square-plate capacitor of side a is given.

537.226

2295. MOLECULAR THEORY OF THE DIELECTRIC CONSTANT.
L.Jansen.
Phys. Rev., Vol. 112, No. 2, 434-44 (Oct. 15, 1958).

A theory of the static dielectric constant is developed on a quantum-mechanical basis, starting from the Lorentz microscopic field equations. By introducing the concept of "local field", a molecular version of the general theory is obtained and applied to compressed non-(di)polar gases at low densities. This leads to a virial series for the dielectric constant. It is shown that such a molecular theory is fundamentally ineffective in accounting for the observed results within the experimental accuracy.

537.226.08

2296. MEASUREMENT OF THE DIELECTRIC PROPERTIES OF LOW LOSS MATERIALS AT MILLIMETER WAVELENGTHS.
A.G.Mungall.
Canad. J. Phys., Vol. 36, No. 12, 1672-7 (Dec., 1958).

Measurement at millimetre wavelengths of the dielectric properties of low-loss materials by a free space technique is described. The dielectric constant is determined from the Brewster angle, and the dielectric loss tangent from the attenuation coefficient measured at the Brewster angle of incidence. Results are given for bakelite at wavelengths between 5 and 10 mm. Details of the instrument, which was specifically designed for these measurements, are also given.

537.226.1

2297. POLARIZATION FLUCTUATIONS IN A FERROELECTRIC CRYSTAL. R.E.Burgess.
Canad. J. Phys., Vol. 36, No. 11, 1569-81 (Nov., 1958).

The theory of thermal fluctuations of electrical polarization in a ferroelectric crystal is considered with special attention to temperatures in the neighbourhood of the Curie point. Models giving a second-order transition are discussed thermodynamically, and the free energy with its derivatives yield the mean value and variance of dipole moment. The fluctuations and their spectral density are related respectively to the real and imaginary parts of the susceptibility of the crystal in conformity with Nyquist's theorem, which is not violated by the presence of a constant applied electric field. The g—r. theorem is shown to be applicable to equilibrium and non-equilibrium conditions, and its extension to lambda-point phenomena generally is discussed.

537.226.1

2298. A PHENOMENOLOGICAL THEORY OF INDUCED ELECTRICAL POLARIZATION. J.R.Wait.
Canad. J. Phys., Vol. 36, No. 12, 1634-44 (Dec., 1958).

A brief theoretical derivation is presented for the effective conductivity and dielectric constant of a homogeneous medium loaded with a uniform distribution of spherical conducting particles. To account for the effect of induced polarization, the particles are taken to have a concentric membrane or film which has a blocking action to the current flow into the particle. The characteristics of this phenomenological model are very similar to the experimentally observed features of induced polarization in a block of compacted andesite particles which contains a dissemination of small metal particles and is partially saturated with a weak electrolyte. The theory is then extended to a two-layer medium where the lower region is polarizable. The results explain, at least in a qualitative way, the observed features of induced electrical polarization in rocks, soils, and clay.

537.226.1

2299. ANOMALOUS DISPERSION IN ARTIFICIAL DIELECTRICS.
A.F.Wickersham, Jr.
J. appl. Phys., Vol. 29, No. 11, 1537-42 (Nov., 1958).

Measurements were made of the anomalous dispersion occurring in certain types of artificial dielectric. To a limited extent the dependence of dispersion on array and scattering element geometry was determined and an attempt made to control dispersion by changing the array configuration. Applications are mentioned briefly.

537.226.1 : 539.2

DIELECTRIC RELAXATION OF LATTICE DEFECTS IN CRYSTALS. See Abstr. 1868

537.226.1

2300. THEORY OF THE FERROELECTRIC EFFECT IN ROCHELLE SALT. T.Mitsui.
Phys. Rev., Vol. 111, No. 5, 1259-67 (Sept. 1, 1958).

Mueller's phenomenological theory of Rochelle salt, $NaKC_4H_4O_6.4H_2O$, is generalized, and the properties of the clamped crystal described. A local field theory of the clamped crystal is developed on the basis of the structure analysis of Frazer, Danner, and Pepinsky. Special care is taken to avoid any arbitrary assumptions in the theory. A chart is given which shows conditions for the occurrence of ferroelectricity. It is shown that the difficulties of Mason and Devonshire's theories are the results of too simplified assumptions on the coefficients of the local field. Various quantities which appear in the theory are calculated using the fact that the reciprocal susceptibility of the clamped crystal has a single zero value. The calculated coefficients which appear in the Taylor series expansion of Helmholtz free energy agree well with those predicted by the phenomenological theory. An explanation is given for the properties of the mixed crystal series, $Na[K_\alpha(NH_4)_{1-\alpha}]C_4H_4O_6.4H_2O$.

537.226.2

2301. DIELECTRIC CONSTANT OF DEUTERIUM OXIDE.
C.G.Malmberg.
J. Res. Nat. Bur. Stand., Vol. 60, No. 6, 609-12 (June, 1958).

An equal ratio-arm, capacitance—conductance bridge operated at frequencies below 100 kilocycles per second was used to measure the dielectric constant of deuterium oxide with an accuracy of 0.1 per cent or better in the range 4° to 100°C. A value of 77.94 was found for the dielectric constant at 25°C. The data fit the relation

$$\epsilon = 87.48_2 - (0.40509)t + (9.638 \times 10^{-4})t^2 - (1.333 \times 10^{-6})t^3,$$

with a maximum deviation of less than 0.01 unit in dielectric constant. These values were obtained by using a sample having a deuterium oxide content of 99.38 mole per cent. Deviation of these values from those for pure deuterium oxide, as a result of isotopic contamination, is estimated to be less than 0.005 unit. Some aspects of the temperature dependence of the dielectric constant and of that of a macroscopic polarization are discussed.

537.226.2

2302. EFFECT OF ADDITION OF TALC ON THE DIELECTRIC PROPERTIES OF ROSIN. R.C.Gupta and B.P.Pradhan.
J. sci. industr. Res., Vol. 17B, No. 11, 448-50 (Nov., 1958).

The dielectric properties of five grades of talc and six varieties of rosin, and their mixtures have been studied using the standing-wave technique in the 10 cm microwave region. The error in the values determined is within 0.45% for talcs, 0.24% for rosins, and within 0.1% for their mixtures. The error for tan δ is below 4% for rosins and rosin-talc mixtures. The effect of adding talc to rosin is discussed.

537.226.2

2303. THE MEASUREMENT AT LOW FREQUENCIES OF THE DIELECTRIC CONSTANT OF CONDUCTING LIQUIDS. V.L.Little.
Proc. Phys. Soc., Vol. 72, Pt 3, 441-6 (Sept., 1958).

The dielectric constants of aqueous solutions of the chlorides o Li, Na, K, Rb and Cs were measured over the concentration range from 10^{-4} to 10^{-2} N at 25°C, using a novel form of electrometer. An accuracy to ±½% is claimed, and the results indicate that the fall in dielectric constant at concentrations below 10^{-3} N is proportional to the square root of the concentration.

537.226.2 : 548.736.3 : 535.39

DIELECTRIC CONSTANT OF MgF_2. See Abstr. 2239

537.226.2

2304. FERROELECTRICITY IN DI-GLYCINE NITRATE $(NH_2CH_2COOH)_2{\cdot}HNO_3$.
R.Pepinsky, K.Vedam, S.Hoshino and Y.Okaya.
Phys. Rev., Vol. 111, No. 2, 430-2 (July 15, 1958).

$(Glycine)_2{\cdot}HNO_3$ is ferroelectric below −67°C. The room-temperature phase is monoclinic, space group $P2_1/a$, with $a = 9.49_6$ A, $b = 5.10_7$ A, $c = 9.35_0$ A, $\beta = 98.8^0$, $\rho_{obs} = 1.581_0$ g/cm³, and Z = 2. The nitrate groups must be disordered or rotating in this phase, since they are at centres of symmetry. The symmetry of the ferroelectric phase is Pa, as established from systematic absences and the fact that spontaneous polarization appears along the room-temperature [101] direction below −67°C. The dielectric constant $\epsilon_{[101]}$, at 10 kc/s and 5 V/cm, is 14 at room temperature, rises to a sharp peak of ~600 at −67°C, and falls to ~12 at −180°C. The transition appears to be of second order. At −77°C the spontaneous polarization is 0.60 μcoul/cm², and the coercive field is 400 V/cm. A specific heat anomaly similar to that in $(glycine)_3{\cdot}H_2SO_4$ and $(glycine)_3{\cdot}H_2BeF_4$ is observed, with ΔE = 0.15 kcal/mole and ΔS = 0.74 cal/mole deg.

537.226.2 : 539.3

2305. ENERGY LOSS PROCESSES IN FERROELECTRIC CERAMICS. B.Lewis.
Proc. Phys. Soc., Vol. 73, Pt 1, 17-24 (Jan., 1959).

By a study of ageing effects in which permittivity, elastic compliance and the electrical and mechanical loss coefficients decrease with time, the principal ferroelectric loss process in low fields is identified as microhysteresis associated with small-amplitude domain boundary movement. Larger fields produce macrohysteresi effects due to large-scale boundary movement, and the permittivity, compliance and loss coefficients are increased. Although boundary movement is responsible for almost all the energy loss, its contribution to permittivity and compliance is usually small compared with induced effects within each domain. Thus a change in the magnitude of boundary movement alters the permittivity and compliance only slightly, but changes the loss coefficients considerably.

537.226.2

2306. CONTRIBUTION TO THE THEORY OF DOMAIN WALLS IN FERROELECTRICS. V.A.Zhirnov.
Zh. eksper. teor. Fiz., Vol. 35, No. 5(11), 1175-80 (1958). In Russi

Transition regions in the 180° and 90° boundaries of ferroelectric domains in barium titanate are considered. The equilibrium variation of the spontaneous polarization vector is deduced from the condition of minimum of thermodynamic potential. Explicit expressions for the thickness and surface energy of the domain boundaries were obtained and numerical estimates are made. The 180° domain boundary in the Rochelle salt crystal is considered.

537.226

2307. SOME EXPERIMENTS ON THE MOTION OF 180° DOMAIN WALLS IN $BaTiO_3$. R.C.Miller.
Phys. Rev., Vol. 111, No. 3, 736-9 (Aug. 1, 1958).

Single-crystal $BaTiO_3$ samples with aqueous LiCl electrodes i place of the customary noble metal electrodes are observed to undergo polarization reversal with electric fields of several hundreds of volts per cm in a manner very much analogous to certain ferromagnetic materials. It is shown for the first time that polarization reversal in $BaTiO_3$ can take place by the expansion of a few domains through extensive sideways 180° domain wall motion. The observed domain configurations show that the smallest switched domains are probably circular in cross-section and do not appear t go through the thickness direction of the crystal. The small domai grow through sideways 180° domain wall motion into large ones which have approximately square cross-sections with the straight sides at 45° to the a-axes. It is also noted that few, and sometimes no, ferroelectric Barkhausen pulses are observed during polarization reversal, and that Barkhausen pulses can occur when two switched domains come together.

537.226.2

2308. FERROELECTRIC PROPERTIES OF A NUMBER OF SOLID SOLUTIONS IN THE SYSTEM $(Ba,Sr)(Ti,Sn)O_3$ IN WEAK AND STRONG ELECTRIC FIELDS. A.I.Medovoĭ.
Zh. tekh. Fiz., Vol. 28, No. 5, 1006-11 (1958). In Russian.

It is shown that the investigated solid solutions in the system $(Ba,Sr)(Ti,Sn)O_3$ form a continuous series of first-type solid solutions. A study was made of the temperature dependence of permittivity in weak and strong electric fields and the dielectric loss angle in weak fields.

537.226.2 : 539.219

STRUCTURAL TRANSITIONS IN BARIUM TITANATE–ZIRCONATE TRANSDUCER MATERIALS. See Abstr. 1895

537.228 : 532.5

2309. BORN-LERTES EFFECT ON THE DIPOLAR ROTATION OF LIQUIDS. E.Grossetti.
Nuovo Cimento, Vol. 10, No. 2, 193-9 (Oct. 16, 1958).

The rotation moments of some polar liquids in a rotating electrical field were determined for frequency values between 0.325 Mc/s and 8.5 Mc/s. The noticeable differences found between the experimental values and the theoretical ones are imputed to a change of conductivity and dielectric constant due to the frequency change.

ELECTRIC CONDUCTION

SEMICONDUCTORS

537.311.31 : 536.424.1

2310. THE INFLUENCE OF THE MARTENSITIC TRANSFORMATION ON THE ELECTRICAL RESISTANCE OF SODIUM.
D.Gugan and J.S.Dugdale.
Canad. J. Phys., Vol. 36, No. 9, 1248-50 (Sept., 1958).

Resistance changes in sodium in the region of 4 to 70°K are accompanied by very pronounced temperature hysteresis and it is considered that the changes (up to 11%) are due to the martensitic transformation to a hexagonal close-packed structure of part of the specimens. K.W.Plessner

537.311.31 : 537.312.62

2311. ELECTRICAL RESISTANCE AND SUPERCONDUCTIVITY OF EVAPORATED GALLIUM FILMS. F.Baumann.
Nachr. Akad. Wiss. Göttingen, math.-phys. Kl. IIa, 1956, No. 15, 285-95. In German.

Films deposited at various temperatures T between 14° and 78°K are found to show the same subsequent annealing effects as films which have been deposited at 4°K and then heated to temperature T. The behaviour is substantially independent of film thickness, between 100 and 2000 A. After annealing at room temperature, the transition temperature for a pure Ga film falls to 1°K; for a film alloyed with 10% Cu it stays at about 7°K. R.G.Chambers

537.311.31

2312. NON-SUPERCONDUCTORS AT LOW TEMPERATURES.
H.Weyerer.
Z. Naturforsch., Vol. 13a, No. 5, 402-4 (May, 1958). In German.

Discusses possible applications of the author's electron-pair theory of superconductivity (see Abstr. 2355/1959) to the resistance minimum in non-superconductors and to ferromagnetic thin films. R.G.Chambers

537.311.31 : 538.632 : 621.317.79

2313. ALTERNATE CURRENT APPARATUS FOR MEASURING THE ORDINARY HALL COEFFICIENT OF FERROMAGNETIC METALS AND SEMICONDUCTORS. J.M.Lavine.
Rev. sci. Instrum., Vol. 29, No. 11, 970-6 (Nov., 1958).

An alternating electric field at 1000 c/s is used with a static magnetic field. The apparatus has a sensitivity of 10^{-18} W, a noise level of 10^{-9} V, and a voltage resolution of one part in 10^5. The sensitivity is required by the small ordinary Hall coefficient of the metals and the ferrites, and the resolution is needed to separate the ordinary and extraordinary Hall effects. The apparatus may be used with sample impedances ranging from less than one ohm to several thousand ohms. The sample holders which are an important part of the apparatus are described. The measurement technique is detailed as is a method for ensuring the absence of spurious voltages. The system may also be used to measure changes in other second-order effects by bucking out all first-order effects.

537.311.31 : 538.632

2314. HALL EFFECT IN Lu, Yb, Tm, AND Sm.
G.S.Anderson, S.Legvold and F.H.Spedding.
Phys. Rev., Vol. 111, No. 5, 1257-8 (Sept. 1, 1958).

The effect was studied as a function of temperature for the temperature range from 40° to 320°K in a magnetic field of 5500 Oe. The Hall coefficient for Yb is positive, while those for Lu and Tm are negative. Sm has a negative Hall effect at room temperature, but at lower temperatures the sign apparently changes.

537.311.31 : 538.632

2315. HALL EFFECT IN PURE NICKEL AT HELIUM TEMPERATURES.
N.V.Volkenshtein, G.V.Fedorev and S.V.Vonsovskiĭ.
Zh. eksper. teor. Fiz., Vol. 35, No. 1(7), 85-8 (1958). In Russian.

Experimental data are presented for an extensive temperature range down to the temperature of liquid helium. It is shown that the ferromagnetic constant R_1 sharply drops with the temperature and has a minimum at 20-30°K. A physical interpretation of the observed phenomena is proposed, which is based on the (s–d) exchange model.

537.311.31 : 539.2

2316. ISOTOPIC EFFECT IN THE RESIDUAL ELECTRICAL RESISTANCE OF METALS. I.Ya.Pomeranchuk.
Zh. eksper. teor. Fiz., Vol. 35, No. 4(10), 992-5 (1958). In Russian.

The existence of various isotopes in a metal leads to a difference in the zero vibrations in accord with the difference of the masses of the isotopes. This in turn leads to the appearance of a nonregular perturbing field which is capable of scattering the conduction electrons. Thus, even in crystals which do not contain physical defects or chemical impurities, a residual electrical resistance may exist. The magnitude of this resistance is estimated.

537.311.32

2317. CONCERNING THE ELECTRICAL CONDUCTIVITY OF CALCIUM FLUORIDE. T.Baak.
J. chem. Phys., Vol. 29, No. 5, 1195 (Nov., 1958).

Ure's expression for the conductivity of CaF_2 (Abstr. 7860/1957), applies between 600°C and the melting point (1418°C). Conductivity is due to anti-Frenkel defects; at the melting point, crystalline CaF_2 can at most accommodate 4.5% of the theoretical number of anti-Frenkel defects. The mechanism of conduction in the molten state is discussed. J.Franks

537.311.33 : 77

2318. METHOD FOR MAKING CONDUCTIVITY INHOMOGENEITIES IN SEMICONDUCTORS VISIBLE.
K.W.Böer, H.J.Hänsch and U.Kümmel.
Naturwissenschaften, Vol. 45, No. 19, 460 (1958). In German.

This consists of taking microphotographs, using monochromatic light with a wavelength near the absorption edge of the semiconductor, while a current is flowing through it. R.Stratton

537.311.33

2319. EXPERIMENTAL EVIDENCE FOR CARRIERS WITH NEGATIVE MASS.
G.C.Dousmanis, R.C.Duncan, Jr, J.J.Thomas and R.C.Williams.
Phys. Rev. Letters, Vol. 1, No. 11, 404-7 (Dec. 1, 1958).

Cyclotron resonance experiments on Ge, using a circularly polarized r.f. field and a steady field along the (100) axis, show a dip in the spectrum corresponding to power emission rather than absorption. The position and behaviour of the dip agree roughly with expectation for the negative-mass heavy holes predicted earlier (Abstr. 6968/1958). R.G.Chambers

537.311.33

2320. DECAY OF EXCESS CARRIERS IN SEMICONDUCTORS.
K.C.Nomura and J.S.Blakemore.
Phys. Rev., Vol. 112, No. 5, 1607-15 (Dec. 1, 1958).

A discussion is given of the non-linear differential equations which govern the decay of excess carriers with arbitrary densities. The form of decay is explored for situations where the Fermi level is in the same half of the energy gap as the recombination level; criteria are established for both strong and weak trapping in addition to recombinative action. Analytic results are augmented and illustrated by numerically computed decay curves for a variety of circumstances. The separate solutions for holes and electrons are combined to show various kinds of behaviour for photoconductive lifetime.

537.311.33

2321. TIME DEPENDENT CHANGES IN EXCESS CARRIER CONCENTRATIONS IN THE PRESENCE OF SURFACE RECOMBINATION. J.D.Nixon and P.C.Banbury.
Proc. Phys. Soc., Vol. 73, Pt 1, 54-8 (Jan., 1959).

A system is considered in which a thin slab of semiconductor, of infinite bulk lifetime, is initially in equilibrium and is then subjected to a uniform excitation throughout the bulk. The case in which surface recombination takes place via Shockley–Read centres was treated, and the time dependence of the transient change in carrier concentrations was evaluated under certain approximations for the case of germanium, as a function of surface potential. The time constants differ from the steady-state lifetime except in the case of low trap densities.

537.311.33

2322. EFFECTS OF CARRIER INJECTION ON THE RECOMBINATION VELOCITY IN SEMICONDUCTOR SURFACES. G.C.Dousmanis.
J. appl. Phys., Vol. 30, No. 2, 180-4 (Feb., 1959).

The effects of carrier injection on the surface recombination velocity are discussed on the basis of the Shockley–Read model. The relevant parameters are the surface potential ϕ_s, bulk resistivity, the injection density δn, and the properties of the surface states. At low injection the behaviour of the surface recombination velocity s can be described by excursions over the usual s v. ϕ_s curves and, depending on the values of the various parameters, s can either increase or decrease with injection. At high injection s approaches a constant value that depends only on the cross-sections and densities of the recombination states, and can be larger (as is predicted for the case of Ge) or smaller than the plateau value of the near-equilibrium curve. The predictions of the theory are illustrated with curves of s v. the fractional excess carrier density $\delta n/n_0$ where, in the case of Ge, use is made of experimentally determined surface parameters. The curves can be used in applied work as a guide in controlling and possibly utilizing the effects of injection on s. The effects of appreciable injection on s could be used for studying the surface recombination centres.

537.311.33

2323. SEMICONDUCTOR SURFACE POTENTIAL AND SURFACE STATES FROM FIELD-INDUCED CHANGES IN SURFACE RECOMBINATION. G.C.Dousmanis.
Phys. Rev., Vol. 112, No. 2, 369-80 (Oct. 15, 1958).

Experiments are reported on the effects of a.c. electric fields and ambients on the surface recombination velocity in germanium and silicon. The variations in surface recombination are detected by changes in the reverse current of large area "back surface" diodes. The experimental method is an improved version of that of Thomas and Rediker and is a convenient means of exploring surface type, stability, time effects at the surface, and effects induced by high a.c. fields and ambients on the slow surface states. Observation of a maximum of surface recombination in terms of applied field provides a reference point from which the zero-field value of the surface potential can be evaluated, and the dependence of the surface recombination velocity (s) on the surface potential (ϕ_s) can be established. Values of ϕ_s are in the range of ±0.25 v in Ge and ±0.5 V in Si. The energies of the main recombination states are at 6 kT to 9 kT from mid-gap in Ge and at +16 kT or −16 kT in Si. Information on the surface potential and the surface states obtained by the present technique is in reasonable agreement with that derived from other types of measurements. The present results are independent of uncertainties due to surface mobility. Experimental patterns show directly that the "charge" surface states are also the ones that give rise to surface recombination. The width of the observed curves of s vs induced charge (and ϕ_s) depends on bulk resistivity and is smaller for the higher resistivity samples. Such behaviour could arise from contributions to s from recombination states distributed in the surface space-charge region.

537.311.33

2324. GENERATION-RECOMBINATION NOISE IN A TWO-LEVEL IMPURITY SEMICONDUCTOR. S.Teitler.
J. appl. Phys., Vol. 29, No. 11, 1585-7 (Nov., 1958).

A general expression for the generation-recombination noise is derived. Application is then made to zinc-doped germanium in the dark from 20° to 100°K. The total white noise in this case exhibits a maximum and a minimum as the temperature is increased and the contributions to the noise which can be associated with the individua levels vary.

537.311.33

2325. NON-EQUILIBRIUM PROCESSES IN IMPURITY SEMICONDUCTORS. V.P.Shabanskiĭ.
Zh. eksper. teor. Fiz., Vol. 35, No. 1(7), 143-53 (1958). In Russian.

Kinetic equations for impurity semiconductors which take into account transitions from impurity levels to the conduction band are considered. An explicit expression for the energy and kinetic coefficients are given for cases when the lifetime of the electrons in the conduction band is determined by photo- and triple recombination processes, it being assumed that the free electron (hole) distribution function has the form of an equilibrium distribution function with a certain effective temperature. Non-radiative transitions which differ from the triple recombination non-radiative transitions are introduced phenomenologically. In this case, due to such transitions in the equilibrium state, the kinetic and energy coefficients can be expressed in terms of the electron lifetime. The equations thus obtained permit one to determine the electron temperature and the number of electrons in the conduction band in various nonequilibrium processes.

537.311.3

2326. N-TYPE AND P-TYPE CONDUCTION IN ALKALI-ANTIMONIDE PHOTOEMITTERS. A.H.Sommer.
J. appl. Phys., Vol. 29, No. 11, 1568-9 (Nov., 1958).

Conductivity measurements were made during the formation of alkali antimonides to deduce whether these materials are p-type o n-type conductors. Reproducible results were obtained, indicating that K_3Sb and Na_3Sb are n-type while Cs_3Sb and the multialkali antimonides are p-type. A correlation between high-quantum efficienc of photoemission and p-type conduction is suggested.

537.311.33 : 535.39

ENERGY GAP IN Bi_2Te_3. See Abstr. 2238

537.311.33 : 621.38

2327. 1/f NOISE IN GERMANIUM DEVICES. T.B.Watkins.
Proc. Phys. Soc., Vol. 73, Pt 1, 59-68 (Jan. 1, 1959).

A number of theories have recently been proposed to explain 1/f noise in germanium filaments. These theories may be extende to germanium devices and suggest experiments which may be performed to give evidence of their validity. Specially made diodes with a free surface opposite the junction were used and simultaneou field effect and noise measurements were made in an attempt to correlate the noise with surface properties. A study of noise in the breakdown region of a reverse biased p–n junction was carried out The results of all the experiments are discussed and a noise model suggested by one of the theories tentatively proposed.

537.311.33 : 539.

EFFECT OF GROWTH VARIABLES ON ELECTRICAL PROPERTIES OF GERMANIUM. See Abstr. 1875

537.311.3

2328. ELECTRICAL CONDUCTION IN N-TYPE InSb BETWEEN 2°K AND 300°K. E.H.Putley.
Proc. Phys. Soc., Vol. 73, Pt 2, 280-90 (Feb., 1959).

Using a digital recording technique the electrical conductivity and Hall coefficient was measured between 2°K and 300°K for samples of InSb containing from 10^{18} down to 5×10^{13} conduction electrons cm^{-3}. The behaviour of the Hall mobility was accounted for a combination of acoustic lattice and ionized impurity scattering a the concentration of scattering centres estimated. The intrinsic carrier concentration was calculated from the results obtained abo 180°K while the results below 20°K show no evidence of a donor activation energy even in the purest material. At 4°K deviations from ohmic behaviour were observed for fields above 0.1 V/cm.

537.311.33 : 669.0

PRODUCTION OF INDIUM ANTIMONIDE OF A HIGH DEGRE OF PURITY BY ZONE REFINING. See Abstr. 1989

537.311.33 : 538.

2329. THE NERNST–ETTINGSHAUSEN EFFECT IN MERCURY TELLURIDE. I.M.Tsidil'kovskiĭ.
Zh. tekh. Fiz., Vol. 27, No. 8, 1744-52 (1957). In Russian. Englis translation in: Soviet Physics — Technical Physics (New York), Vol. 2, No. 8, 1622-8 (Aug., 1957).

The paper analyses the Nernst–Ettingshausen effect, electric conductivity and Hall effect in mercury telluride (HgTe). The dependence of the Nernst-Ettingshausen field can be adequately explained by means of the theory of thermomagnetic phenomena. The Nernst—Ettingshausen data made it possible to evaluate the ratio between the electron and hole mobilities. The theory of the Nernst—Ettingshausen effect in the case of strong magnetic fields and equal current carrier concentrations was verified.

537.311.33 : 538.63

2330. MAGNETORESISTANCE IN PbS, PbSe, AND PbTe AT 295°, 77.4°, AND 4.2°K.

R.S.Allgaier.

Phys. Rev., Vol. 112, No. 3, 828-36 (Nov. 1, 1958).

Magnetoresistance measurements made on 14 single crystals of PbS, PbSe, and PbTe at 77.4°K conformed to the general phenomenological weak-field theory; i.e. the magnetoresistance was proportional to H^2, and varied sinusoidally with the angle between the sample current and magnetic field. Because of the extremely high mobilities in the samples at 4.2°K, weak-field theory was generally not applicable, and saturation effects and striking deviations from the sinusoidal behaviour were observed at this temperature. The longitudinal magnetoresistance was generally larger (in some cases, 4 or 5 times larger) than the transverse at both 77.4° and 4.2°K. The results did not appear to be significantly different for n- and p-type material. The data generally favour a model with considerable mass anisotropy; in particular, the many-valley model having ellipsoids of revolution along the ⟨111⟩ directions, with a ratio of longitudinal to transverse effective mass of between 4 and 6, seems most appropriate for PbTe.

537.311.33

2331. THE MEASUREMENT OF SURFACE RECOMBINATION VELOCITY ON SILICON.

A.H.Benny and F.D.Morten.

Proc. Phys. Soc., Vol. 72, Pt 6, 1007-12 (Dec., 1958).

The determination of the surface recombination velocity on a silicon filament by measurement of the spectral distribution of the photoconductivity is described. Results are presented indicating surface recombination velocities on etched surfaces of less than 75 cm sec^{-1} in dry oxygen, and greater than 7500 cm sec^{-1} in wet nitrogen. The measurements indicate that the surface recombination velocity may be a function of the carrier concentration at the surface.

537.311.33

2332. VALENCE BAND STRUCTURE OF SILICON.

L.Huldt and T.Staflin.

Phys. Rev. Letters, Vol. 1, No. 9, 313-15 (Nov. 1, 1958).

The existence of two kinds of holes in p-type silicon is demonstrated by optical absorption measurements as a function of optically-generated free carrier density, and the results confirm the predictions from cyclotron resonance experiments. The experimental techniques enable impurity absorption effects to be detected at room temperature.

C.A.Hogarth

537.311.33

2333. MICROWAVE SPIN ECHOES FROM DONOR ELECTRONS IN SILICON.

J.P.Gordon and K.D.Bowers.

Phys. Rev. Letters, Vol. 1, No. 10, 368-70 (Nov. 15, 1958).

Values of transverse relaxation times T_2, obtained from study of microwave spin echo signals from Li- and P-doped Si, change little with donor concentration and type, but show a large increase for P-doped isotopically enriched Si^{28}. Application as a memory device, where each element is capable of storing 10^4 items of information, is envisaged.

G.C.Williams

537.311.33

2334. INVERSION LAYERS ON P-TYPE SILICON.

S.Müller.

Z. Naturforsch., Vol. 12a, No. 2, 112-22 (1957). In German.

N-type channels were formed on the p-type side of a p—n junction by adsorption in an atmosphere of wet nitrogen. Electrical (a.c. and d.c. characteristics) and photoelectric (light probe) experiments are described. The results indicate a channel conductance of 10^{-5} to 10^{-6} ohm^{-1}. Two sets of surface states are discussed, namely "fast" states (short capture times) between the silicon and its oxide layer, and "slow" states (long capture times of about 10 to 50 min) outside the oxide layer. The density of slow states is about 10^{15} cm^{-2}, while the density of fast states is estimated to be considerably greater than the corresponding density of 10^{11} cm^{-2} in Ge.

R.Stratton

537.311.33

2335. THE EFFECT OF VERY HIGH [HYDRAULIC] PRESSURE ON THE ELECTRICAL CONDUCTIVITY OF SILICON.

Yu.N.Ryabinin, L.D.Livshits and L.F.Vereshchagin.

Zh. tekh. Fiz., Vol. 28, No. 7, 1382-6 (1958). In Russian.

Electrical resistance of a p-type, 18 ohm cm Si single crystal was measured at room temperature under hydraulic pressure p varying between 0 and 28 000 kg/cm^2. In contrast to the results obtained by Bridgman (Abstr. 1339/1954) the relative resistance R_p/R_0 decreased with increasing p, reaching the value of 0.987 at 25 000 kg/cm^2, and only small hysteresis was observed. However, different results were obtained when Si test pieces were used to which rectifying characteristics had been imparted by faulty soldering of the leads, and in this case the variation of R_p/R_0 with increasing p was irregular.

M.H.Sloboda

537.311.33

2336. REVERSE BREAKDOWN IN In—Ge ALLOY JUNCTIONS.

D.R.Muss and R.F.Greene.

J. appl. Phys., Vol. 29, No. 11, 1534-7 (Nov., 1958).

Experimental information is presented which shows that abrupt p^+n junctions break down by the Zener internal field emission effect when the base resistivity is low and by ionization avalanche when the base resistivity is high. In intermediate regions of base resistivity both mechanisms are observed in the same junction. The onset of Zener current is accompanied by a drop, of unexplained origin, in the junction collection efficiency for minority carriers photoinjected into the base. Applicability of the Zener theory to abrupt p^+n junctions is discussed.

537.311.33 : 539.166.08

A SEMICONDUCTING DEVICE FOR DETECTION OF GAMMA-RAYS. See Abstr. 1748

537.311.33 : 535.376

IMPURITY BANDS AND ELECTROLUMINESCENCE IN SiC P—N JUNCTIONS. See Abstr. 2229

537.311.4 : 541.183.2

USING CONTACT RESISTANCE TO MEASURE ADSORPTION OF GASES ON METALS. See Abstr. 1927

537.311.62

2337. INFLUENCE OF THERMOELECTRIC FORCES ON THE SKIN EFFECT IN METALS.

M.I.Kaganov and V.M.Tsukernik.

Zh. eksper. teor. Fiz., Vol. 35, No. 2(8), 474-8 (1958). In Russian.

The surface impedance of a metal is computed allowing for the thermoelectric forces.

537.311.62 : 539.2

ANOMALOUS SKIN EFFECT IN A MAGNETIC FIELD. See Abstr. 1884

537.312.5

2338. ON THE INFLUENCE OF THE DIELECTRIC AFTER-EFFECT ON THE CONDUCTION PROCESS IN CdS SINGLE CRYSTALS IN THE REGION OF THE BREAKDOWN FIELD.

K.W.Böer and U.Kümmel.

Ann. Phys. (Leipzig), Vol. 20, No. 1-6, 303-14 (1957). In German.

Experiments on the decay of photoconductivity in single crystals which had been subjected to various high field pulses indicate the presence of dielectric after-effects due to nonhomogeneous samples. The results of the various experiments are given a qualitative interpretation. Such dielectric after-effects will influence the electrical conductivity at high field strengths.

R.Stratton

537.312.5 : 535.345

2339. PHOTOCONDUCTIVITY AS A FUNCTION OF OPTICAL ABSORPTION.

A.M.Goodman.

J. appl. Phys., Vol. 30, No. 2, 144-7 (Feb., 1959).

A theoretical analysis of the dependence of photoconductivity upon optical absorption is presented, based upon the concept of a "schubweg" or mean range for the optically liberated charge carriers of each sign. The analysis is based upon a model in which the light is normally incident upon a flat slab semiconductor. The electric field within the semiconductor is assumed to be either parallel or antiparallel to the direction of propagation of the incident light. The photocurrents are different for the two field directions. The ratio of the photocurrent for the parallel field direction to the photocurrent for the antiparallel field direction is found to be independent of incident light intensity, optical reflection coefficient at the front face of the slab, and photon quantum efficiency for hole—electron pair creation. The limitations of the assumed model are discussed.

537.312.5

2340. TRANSIENT PHOTOCONDUCTIVITY IN AgCl AT ROOM TEMPERATURE. F.C.Brown.
J. Phys. Chem. Solids, Vol. 4, No. 3, 206-16 (1958).

At room temperature silver chloride is an ionic conductor having a relaxation time for polarization of several hundred μsec. A fast-pulse technique is described which makes possible the separation of electronic from ionic currents in this material at 25°C. Primary photoresponse in essential agreement with a simple trapping model is observed. The factors which influence electron lifetimes in pure silver chloride were investigated for crystals containing only a few tenths of a part per million of heavy-metal impurities. A relatively low photoconductive response corresponding to electron lifetimes before trapping of 10^{-8} sec or less was found for crystals grown from the melt in vacuum, in a halogen, or in an inert atmosphere. This applies to well-annealed samples and to materials for which precautions were taken to remove water and the products of hydrolysis (Ag and Ag_2O). On the other hand, when crystals are grown in air or from a moist starting charge, electron lifetimes as long as 10 μsec may result. The contribution of holes to fast photoresponse was not observed and must be quite small. For example, in the case of a crystal having a large response at 1000 V/cm field, the ratio of hole range to electron range was found to be < 0.012, yielding an upper limit of hole lifetime of 4×10^{-9} sec. From measurements with single pulses, the drift mobility of electrons at 26°C is found to 46 ± 4 cm^2/V sec, in agreement with print-out Hall experiments.

537.312.5 : 548.736.4

2341. CRYSTAL STRUCTURE AND PHOTOCONDUCTIVITY OF CAESIUM PLUMBOHALIDES. C.K.Møller.
Nature (London), Vol. 182, 1436 (Nov. 22, 1958).

The crystal structures of $CsPbCl_3$, $CsPbBr_3$ and $CsPbI_3$ at room temperature and above were determined. With perovskite structure, these crystals are photoconductors with sensitivity peaks in the visible. J.Franks

537.312.5

2342. PHOTOCONDUCTIVITY OF CdS SINGLE CRYSTALS. H.Gutjahr.
Z. Naturforsch., Vol. 12a, No. 12, 1021-2 (1957). In German.

Maxima in the photosensitivity of CdS occur at the absorption edge in the range 5000-5500 A. A new maximum is reported at 5240 A. The height and position of the maxima can individually be varied by annealing, by changing the excitation intensity, and by auxiliary radiation. The sensitivity can be extended to 9000 A by activation with Co or Au, or by annealing in O_2. J.Franks

537.312.5

2343. ON THE LATERAL PHOTOVOLTAIC EFFECT IN P—N JUNCTIONS. P.Gosar.
C.R. Acad. Sci. (Paris), Vol. 247, No. 22, 1975-8 (Dec. 1, 1958). In French.

The effect is produced between two different points of the p-type part of a p—n photo-junction, or between two different points of the n-type part. Simple one-dimensional considerations are given to study the effect theoretically. P.T.Landsberg

537.312.5

2344. HIGH-VOLTAGE PHOTOVOLTAIC EFFECT. B.Goldstein and L.Pensak.
J. appl. Phys., Vol. 30, No. 2, 155-61 (Feb., 1959).

Vacuum evaporated films of cadium telluride were prepared that show photovoltages as high as 100 V/cm of film length. An oblique angle of deposition of the vapour on to the substrate is required. The photovoltage saturates at high light intensities and low temperatures. At all other light intensities and temperatures it has the same functional dependence on light intensity as that of ordinary p—n junctions. The short-circuit current varies linearly with light intensity at all temperatures and is only weakly temperature-dependent. Analysis of the data suggests a series of p—n junctions (or other photovoltaic elements) arrayed in an additive manner. Estimates of the linear density of photovoltaic elements based on the measurements described above vary from ~200 per cm at room temperature to ~7000 per cm at −170°C. A possible mechanism to explain the effect is proposed, based on an anisotropic growth of crystallites due to the angle of deposition, and on the presence of residual gases in the vacuum chamber.

537.312.

2345. PHOTOVOLTAIC EFFECT AND PHOTOCONDUCTIVITY IN LAMINATED ORGANIC SYSTEMS. D.Kearns and M.Calvin.
J. chem. Phys., Vol. 29, No. 4, 950-1 (Oct., 1958).

Photoconductive and photovoltaic spectra were obtained for a cell consisting of a magnesium phthalocyanine disk coated with a thin film of air-oxidized tetramethyl p-phenylenediamine. J.Franks

537.312.

2346. OBSERVATION OF THE LATERAL PHOTOVOLTAGE BY SURFACE FIELD EFFECT. M.Kikuchi.
J. Phys. Soc. Japan, Vol. 13, No. 9, 1061 (Sept., 1958).

With an electrode at high potential close to one side of a Ge rod and a light beam focused on the other side, a voltage is developed across the ends of the rod. The magnitude and sign of the voltage depend on the position of the light spot and on whether the Ge is n-or p-type. J.Franks

537.312.62

2347. SOME EXPERIMENTAL ASPECTS OF SUPERCONDUCTIVITY. H.A.Boorse.
Amer. J. Phys., Vol. 27, No. 1, 47-57 (Jan., 1959).

537.312.62

2348. GAUGE INVARIANCE IN THE THEORY OF SUPERCONDUCTIVITY. D.Pines and J.R.Schrieffer.
Nuovo Cimento, Vol. 10, No. 3, 496-504 (Nov. 1, 1958).

It is shown that when due account is taken of the Coulomb interactions between electrons, a theory of superconductivity which gives a satisfactory account of the Meissner effect in the London gauge can be extended to give a satisfactory account in any other gauge. Calculations based on the Bardeen—Pines collective treatment of the electron—phonon system show that in the long waveleng region ($k <\sim k_c \cong r_s^{-1}$ where r_s is the interelectronic spacing) only the plasmons respond to a longitudinal vector potential. Their response is such as to maintain gauge invariance. The individual electrons are surrounded with a screening cloud of virtual plasmon in such a way that they carry no longitudinal current to order (k^2/k_c and are hence unaffected by a longitudinal vector potential to this order. The introduction of the screening cloud is shown to correspond closely to the backflow introduced by Feynman and Cohen to guarantee longitudinal current conservation for the excitations in liquid helium. The calculations are carried out to order m/M and k^4/k_c^4, and involve the use of the random phase approximation for terms which couple plasmons and electrons. For the wavelengths of importance in the Meissner effect ($k \ll k_c$), these approximation are well-justified. An explicit prescription is given for extending the Bardeen, Cooper and Schrieffer derivation of the Meissner effec to an arbitrary gauge, and their results are shown to be essentially unaltered.

537.312.6

2349. VOLUME CHANGES ASSOCIATED WITH THE SUPERCONDUCTING TRANSITION. G.D.Cody.
Phys. Rev., Vol. 111, No. 4, 1078-86 (Aug. 15, 1958).

Measurements were made of the length change associated with the superconducting transition of lead, tin, thallium, indium, and tantalum. For all the metals except tantalum, measurements were made between 1.5° and 4.7°K and the length change observed range from 10^{-6} to 10^{-8} cm. The length change produced a capacitance change in the tank circuit of a stable LC oscillator and the length change was measured in terms of the resultant frequency change. For lead and tantalum the length change can be related to $\partial H_c/\partial P$, i.e. the variation of critical field with pressure and the results obtained in the present work agree with the values obtained for this quantity in previous measurements. For noncubic metals the lengt change can be related to $\partial H_c/\partial \tau$, i.e. the variation of critical field with normal stress. Grenier has shown that this quantity is anisotropic for tin and mercury; the present experiment indicates it to b anisotropic for indium and thallium. The indium anisotropy is of th same order as that observed for tin. The thallium anisotropy is such that $\partial H_c/\partial \tau$ differs in sign for directions perpendicular and parallel to the axis of symmetry of the crystal. An attempt is mad to relate the magnitude and anisotropy of the effect to current theories of the superconducting state.

537.312.

2350. SUPERCONDUCTING TO NORMAL PHASE TRANSITION IN TANTALUM. W.B.Ittner.
Phys. Rev., Vol. 111, No. 6, 1483-7 (Sept. 15, 1958).

Measurements were made of the rate at which the supercondu ng phase collapses radially in a hollow cylindrical tantalum specimen following the sudden application of a longitudinal magnetic field greater than the critical field. The measured transition rates confirm the hypothesis that the propagation is controlled by electromagnetic damping associated with eddy currents generated in the normal phase. The results, moreover, may be interpreted on the basis of a theoretical treatment of the problem first published by Pippard, provided that suitable modifications are incorporated to include the thermal effects which accompany the transition.

537.312.62

2351. EVALUATION OF THE CONTRIBUTION OF THE UMKLAPP-PROCESSES TO THE ELECTRON—PHONON INTERACTION. P.Morel.

Phys. Rev. Letters, Vol. 1, No. 7, 244-5 (Oct. 1, 1958).

In the computation by Pines (Abstr. 619/1958) of the interaction parameter V in the B.C.S. theory of superconductivity (Abstr. 1708/1958) the contribution to V of the umklapp processes is very significant. In Pines' paper the approximation is used that the momentum q of the emitted or absorbed phonons is about equal to the maximum phonon momentum in Debye's theory. In the present paper the exact value of q is used and by this, agreement with experiment is greatly improved. The contribution of the umklapp processes to the phenomena involving electron—phonon interaction is found to amount to 90-98% of the total. H.London

537.312.62 : 536.631

2352. HEAT CAPACITY OF SUPERCONDUCTING ZINC. N.E.Phillips.

Phys. Rev. Letters, Vol. 1, No. 10, 363-5 (Nov. 15, 1958).

The heat capacity of a 99.999% pure zinc crystal in the normal and superconducting states was studied over the temperature range 0.15° to 1.1°K. For the normal metal, it is concluded that the usual equation ($C = \gamma T + \beta T^3$) holds good over the whole temperature range (to an accuracy of 1% above 0.3°K) with $\gamma = 0.66$ millijoules mole^{-1} deg^{-2}. For the superconducting state, it is found that the electronic heat capacity only approximates to the equation $C/\gamma T_c = a \exp(-bT_c/T)$ with values of a and b which are lower than those which would be expected from a law of corresponding states when compared with other superconductors. The value of the critical field at the absolute zero is calculated from the results to be 51.8 gauss, in good agreement with other observers. L.Mackinnon

537.312.62

2353. TWO-FLUID MODEL OF SUPERCONDUCTIVITY. J.Bardeen.

Phys. Rev. Letters, Vol. 1, No. 11, 399-400 (Dec. 1, 1958).

It is shown that, with certain approximations, the B.C.S. theory of superconductivity can be expressed in terms of a two-fluid model. The treatment follows Landau's treatment of liquid helium. R.G.Chambers

537.312.62

2354. EXPERIMENTAL EVIDENCE FOR AN ENERGY GAP IN SUPERCONDUCTORS.

M.A.Biondi, A.T.Forrester, M.P.Garfunkel and C.B.Satterthwaite.

Rev. mod. Phys., Vol. 30, No. 4, 1109-36 (Oct., 1958).

A critical review of evidence from (a) thermal conductivity, specific heat and critical fields, (b) nuclear resonance and relaxation, and (c) microwave and infrared studies of bulk metal and of thin films. About 80 references. R.G.Chambers

537.312.62

2355. SUPERCONDUCTIVITY AND ELECTRON-PAIR MODEL. H.Weyerer.

Z. Naturforsch., Vol. 13a, No. 4, 286-95 (April, 1958). In German.

A qualitative discussion in which the carriers of the supercurrent are seen in freely moving electron pairs. It is assumed that the number of these pairs depends, among other factors, on the temperature and leads to superconductivity when it has reached a certain value. Because of the existence of a finite dissociation energy for the pairs, the densely occupied ground state is separated from the normal state by a finite energy gap. The binding energy is due to a collective interaction of the electron pairs with the lattice. The essential properties of superconductors are interpreted on the basis of this model. H.London

537.312.62

2356. SUPERCONDUCTOR IN A HIGH-FREQUENCY FIELD. A.A.Abrikosov, L.P.Gor'kov and I.M.Khalatnikov.

Zh. eksper. teor. Fiz., Vol. 35, No. 1(7), 265-75 (1958). In Russian.

An equation is derived which describes the behaviour of superconductors in a high-frequency field. The temperature and frequency dependences of the impedance of a massive superconductor are determined with aid of this equation.

537.312.62 : 534.23

ULTRASONIC ATTENUATION IN SUPERCONDUCTING AND NORMAL MERCURY. See Abstr. 2173

537.312.62 : 537.311.31

SUPERCONDUCTIVITY OF EVAPORATED GALLIUM FILMS. See Abstr. 2311

537.312.8

2357. OSCILLATIONS OF THE CONDUCTIVITY OF METALLIC FILMS IN MAGNETIC FIELDS. V.L.Gurevich.

Zh. eksper. teor. Fiz., Vol. 35, No. 3(9), 668-77 (1958). In Russian.

Oscillations of the electrical conductivity of a metallic film located in a magnetic field are considered for an arbitrary dispersion law of the electron energy and for arbitrary orientation of the field. The oscillations are not a quantum effect and are due to the finite thickness of the film and to the diffuse nature of electron reflection from its surface. In contrast to the Shubnikov—de Haas effect, the conductivity in the given case oscillates as a function of H, but not of H^{-1}. Measurements of the oscillation amplitudes and periods permit one to draw conclusions regarding the shape of the Fermi surface in metals.

537.312.8 : 539.2

2358. GALVANOMAGNETIC CHARACTERISTICS OF METALS WITH OPEN FERMI SURFACES. I.M.Lifshits and V.G.Peschanskiĭ.

Zh. eksper. teor. Fiz., Vol. 35, No. 5(11), 1251-64 (1958). In Russian.

Galvanomagnetic phenomena in strong fields are studied for metals with open Fermi surfaces. Characteristic features of the angular dependence of galvanomagnetic parameters on the magnetic field direction are investigated and their relation to the topology of an open surface is elucidated. The possibility, established in principle previously (Abstr. 360/1957) of saturation of the electrical resistance for certain orientations of the magnetic field relative to the crystal axes and of its quadratic increase at other orientations is discussed. Conditions are found under which the resistance can vary linearly with the field as a result of averaging over the orientations of the crystallites in a polycrystalline sample.

537.312.9

2359. PIEZORESISTANCE CONSTANTS OF n-TYPE InAs. A.J.Tuzzolino.

Phys. Rev., Vol. 112, No. 1, 30 (Oct. 1, 1958).

A measurement was made of these constants as a function of temperature from 77° to 300°K. From the small magnitude found for the three constants throughout the temperature range investigated, it is concluded that the results of this experiment are consistent with a spherical conduction-band model for InAs.

537.312.9

2360. PIEZORESISTANCE IN N-TYPE GaAs. A.Sagar.

Phys. Rev., Vol. 112, No. 5, 1533 (Dec. 1, 1958).

Piezoresistance and elastoresistance coefficients of n-type GaAs were determined at room temperature. The results are consistent with a spherical energy-band model as predicted by Callaway (Abstr. 6375/1957) from theory.

537.312.9

2361. PIEZORESISTIVITY IN REDUCED SINGLE-CRYSTAL RUTILE (TiO_2). L.E.Hollander, Jr.

Phys. Rev. Letters, Vol. 1, No. 10, 370-1 (Nov. 15, 1958).

An increase in resistivity with increasing tension is observed with reduced (blue) rutile, and the piezoresistance coefficients determined. C.A.Hogarth

537.321

2362. ON THE THEORY OF THE THERMOELECTRIC POWER IN SEMICONDUCTORS. O.Madelung.

Z. Naturforsch, Vol. 13a, No. 1, 22-5 (Jan., 1958). In German.

The thermodynamic background of the theory is examined in order to clarify ambiguities in the literature. G.C.Williams

537.322

2363. SEEBECK EFFECT FLUCTUATIONS IN GERMANIUM. J.J.Brophy.

Phys. Rev., Vol. 111, No. 4, 1050-2 (Aug. 15, 1958).

Fluctuations in the Seebeck effect or thermoelectric power of germanium single crystals were observed. The Seebeck noise power spectrum varies as reciprocal frequency and may be quantitatively predicted from current-noise measurements. Carrier density fluctuations responsible for 1/f noise are also the source of Seebeck noise. The present results indicate that carrier fluctuations having a 1/f spectrum persist even in the absence of net d.c. current flow. Seebeck noise is also observed in low-noise specimens having non-ohmic, noisy electrodes.

537.323

2364. MEASUREMENTS OF THERMOELECTRICITY BELOW 1°K. II. D.K.C.MacDonald, W.B.Pearson and I.M.Templeton.
Phil. Mag. (Eighth Ser.), Vol. 3, 917-19 (Aug., 1958).

Measurements of the absolute thermoelectric power S of Au and Ag below 1°K were recently reported by the authors in Pt I (Abstr. 5933/1958). This letter reports similar measurements on highly pure specimens of the alkali metals. Li and Cs show the linear variation of S with temperature expected theoretically, but for Na and K the variation is approximately quadratic. D.M.Edwards

537.323

2365. THERMOELECTRIC MEASUREMENTS ON NATURAL GALENA AT LOW TEMPERATURES. D.M.Finlayson and D.Greig.
Proc. Phys. Soc., Vol. 73, Pt 1, 49-53 (Jan., 1959).

The thermoelectric power of n-type single crystals of natural galena was measured down to liquid-hydrogen temperatures. The theory developed by Howarth and Sondheimer (Abstr. 6781/1953) fits the experimental results fairly well. An electron effective mass ratio in the range 0.11-0.19 was obtained. No evidence of phonon drag effects was observed.

537.323 : 536.212

THERMOELECTRIC POWER OF GERMANIUM—SILICON ALLOYS. See Abstr. 2259

537.324

2366. THEORY OF THERMOELECTRIC REFRIGERATION. S.Uchiyama.
Mem. Fac. Engng Nagoya Univ., Vol. 9, No. 2, 321-9 (Nov., 1957).

A theory of the temperature distribution in the n-type and p-type elements of a thermoelectric refrigerator, that takes the Thomson effect into account and eliminates earlier discrepancies between experimental results and theoretical values, is developed. Whereas the maximum temperature difference is smaller, the current corresponding to the maximum temperature difference is larger than predicted by earlier theories. The effect of changing the carrier concentration, along the direction of current flow, and the cross-sectional area of the elements to achieve a maximum temperature difference is investigated. G.C.Williams

537.324

2367. ON THE THEORY OF THERMOELECTRIC COOLING. R.Dahlberg.
Z. angew. Phys., Vol. 10, No. 8, 361-8 (Aug., 1958). In German.

The origins of the thermoelectric effects are examined and the theory of operation of a thermojunction and the design of multijunction coolers are discussed. The results are related to experiments with various materials, in particular Bi_2Te_3, ZnSb, CdSb, As_2Te_3 and other tellurides and selenides. C.A.Hogarth

537.324

2368. ON THE THEORY OF REVERSIBLE ELECTRICAL HEATING. R.Dahlberg.
Z. angew. Phys., Vol. 10, No. 10, 467-70 (Oct., 1958). In German.

Careful analysis of the heating effects obtainable from thermocouples. C.A.Hogarth

ELECTRIC DISCHARGES

537.521 : 538.566

SCATTERING OF MICROWAVE RADIATION BY A PLASMA COLUMN. See Abstr. 1612

537.521.7

2369. OBSERVATIONS ON OVERVOLTED UNIFORM FIELD SPARK GAPS. K.R.Allen and K.Phillips.
Nature (London), Vol. 182, 1083 (Oct. 18, 1958).

Describes cloud-chamber experiments on the growth of mid-gap streamers using 0.1 μsec pulses at values of p × d of 800 (mm Hg) × × cm in air. Photographs showing the growth of the anode and cathode directed streamers from the avalanche head are given. W.G.Townsend

537.523 : 537.531

2370. ENERGY OF THE X-RAY RADIATION EMITTED BY A POWERFUL PULSED DISCHARGE IN HYDROGEN.
N.G.Koval'skiĭ, I.M.Podgornyĭ and S.Khvashchevskiĭ.
Zh. eksper. teor. Fiz., Vol. 35, No. 4(10), 940-6 (1958). In Russian.

The maximal energy of X-ray quanta emitted during a powerful pulsed discharge in hydrogen was determined. The energy values given in the paper were derived by analysis of the recoil electron spectrum measured with a cloud chamber.

537.523

2371. ON THE DELAYED LIGHT EMISSION FROM RARE GAS CORONA. W.F.Bemerl and H.Fetz.
Naturwissenschaften, Vol. 45, No. 16, 381-2 (1958). In German.

Describes briefly an electronic system for recording time re solved u.v. light emission from corona discharges (non-uniform field). Experiments were made with the rare gases. Some result are shown graphically. J.D.Crag

537.523

2372. EXPERIMENTAL STUDIES ON THE MECHANISM OF ELECTRIC SPARK DISCHARGE. U.Shinohara.
Mem. Fac. Engng Nagoya Univ., Vol. 9, No. 2, 201-40 (Nov., 1957)

A lengthy general account of a "space charge theory" of spar breakdown given in general terms, with accompanying experiment background. Exhaustive series of Lichtenberg figure experiments were made; also many measurements,made therefrom, of streame length as a function of gap voltage are given. The work was carri out in air. J.D.Crag

537.525 : 532.5 : 538

2373. HYDROMAGNETIC INSTABILITY IN A STELLARATOR. M.D.Kruskal, J.L.Johnson, M.B.Gottlieb and L.M.Goldman.
Phys. of Fluids, Vol. 1, No. 5, 421-9 (Sept.-Oct., 1958).

When there is a uniform externally imposed longitudinal magnetic field much larger than the field of a discharge current i cylindrical plasma, one should expect instabilities in the form of lateral displacement of the plasma column into a helix of large pit This problem is examined under the conditions which might occur the stellarator during ohmic heating. It is shown that the presenc of external conductors is unimportant. When effects of the finite length of the machine are considered, a critical current is obtaine below which the system is stable to this displacement. Considera tion of the current distributions other than uniform shows that instabilities which vary as $e^{i(m\theta+kz)}$ can occur for values of m gre than one, so that instabilities can be found for any finite length machine. Experimental results are in agreement with the theory the m = 1 mode. There is no experimental indication of the highe m modes, for which several possible explanations are suggested.

537.5

2374. "RUNAWAY" ELECTRONS AND COOPERATIVE PHENOMENA IN B-1 STELLARATOR DISCHARGES.
W.Bernstein, F.F.Chen, M.A.Heald and A.Z.Kranz.
Phys. of Fluids, Vol. 1, No. 5, 430-7 (Sept.-Oct., 1958).

Examination of the temporal distribution, relative intensity, a maximum energy of X-rays above 30 keV emanating from the B-1 stellarator during a pulsed discharge revealed a number of interes ing phenomena. The X-rays are assumed to be reproduced by "ru away" electrons when they strike the wall. Spuriously large pulse heights were observed, The X-rays abruptly appear early in the discharge, before the Kruskal instability can occur. Depending on the operating conditions, X-rays can be observed at any time duri the discharge except when the current is at the Kruskal limiting value. If the longitudinal electric field used for ohmic heating is "crowbarred", X-rays can appear afterwards in copious quantities furthermore, the discharge current can decay in abrupt steps corr lated in time with bursts of X-rays. The hypothesis that the curr in these steps is due entirely to runaway electrons is consistent w the data. These observations are taken to be evidence for the exis ence of cooperative phenomena, or collective motions which can affect both the confinement and the heating of a plasma. In additio intense non-thermal microwave noise was detected at times corre lated with X-ray emission.

537.5

2375. THE DIVERTOR, A DEVICE FOR REDUCING THE IMPURITY LEVEL IN A STELLARATOR.
C.R.Burnett, D.J.Grove, R.W.Palladino, T.H.Stix and K.E.Wakefie
Phys. of Fluids, Vol. 1, No. 5, 438-45 (Sept.-Oct., 1958).

A divertor, designed to reduce the flow of impurities from th wall into a gas discharge, was used with a small stellarator. In th divertor an outer shell of magnetic flux is bent away from the discharge channel into a large auxiliary chamber. Ions diffusing toward the wall tend to follow the lines of force of this outer shell i the divertor chamber. Impurities produced by wall bombardment this chamber do not readily return to the discharge. The magneti design of this device is described, and a phenomenological theory

its performance is outlined. The spectroscopic data with and
hout the divertor activated indicate that the divertor reduces the
lux of impurities by a factor of two to three, while the impurity
ncentration at the core, or central region, may be diminished by
order of magnitude when the divertor is activated. Kinetic tem-
ratures of positive ions determined from spectroscopic measure-
nts of Doppler broadening increase from 40 eV without the divertor
60 eV for He^+ and to 130 eV for O^{++++} with use of the divertor.

537.525
76. SELF-CONTRACTING DISCHARGES IN DEUTERIUM AT
GH CURRENT-RISE RATES. V.S.Komel'kov.
. eksper. teor. Fiz., Vol. 35, No. 1(7), 16-26 (1958). In Russian.
Results of an investigation of self-contracting discharges,
olving rates of current growth of 7×10^{11} and 1.4×10^{12} A/sec
l current amplitudes up to 2×10^6 A, are described. The initial
essure of deuterium in the chambers was varied from 0.1 to
mm Hg. The highest temperature in the gas which was possibly
ained was about 200 eV.

537.525.2 : 537.533.2
ELECTRON EMISSION FROM CONDENSED Hg FILMS IN Hg
C. See Abstr. 1509

537.525.4
77. THE ELECTRICAL BREAKDOWN OF GASES IN UNIFORM
GH FREQUENCY FIELDS AT LOW PRESSURE.
G.Townsend and G.C.Williams.
oc. Phys. Soc., Vol. 72, Pt 5, 823-32 (Nov., 1958).
Electrical breakdown in air and in hydrogen for uniform high
equency and static fields was investigated using a pair of
ometrically similar electrode systems. Static breakdown poten-
ls for values of $pd \leq 15$ mm Hg cm were measured and high-
equency data obtained over a range of frequencies f from 5 Mc/s
70 Mc/s. The results support the view that there is only one mode
breakdown, contrary to the views proposed by many previous
rkers. The similarity relationship was found to be satisfied for
rtain pairs of frequencies provided that the discharge was confined
the regions of uniform field between the electrodes, and that the
ectrode sufaces were clean. On the other hand, when the electrodes
re covered with oxide layers, the similarity theorem did not apply.
is result indicates that at least one process of electron generation
loss was not a function of E/p; the most probable process, cold
nission, was identified by correlating the results with those
tained under similar conditions with static fields.

537.525.5
78. OBSERVATION OF THE PINCH EFFECT DURING
ECREASE OF CURRENT.
L.Granovskiĭ, K.P.Ryumina, V.I.Savoskin and G.G.Timofeeva.
. eksper. teor. Fiz., Vol. 35, No. 1(7), 45-9 (1958). In Russian.
An image converter tube was used to photograph the instan-
neous state of the arc plasma in H_2 and Hg at $p = 10^{-3}$-10^{-2} mm Hg,
rrent pulses of 1.3-5.5 kA and current pulse durations up to
0 μsec. It was found that electrodynamical deformation (compres-
on and bending) of the arc column exists for values $di/dt < 0$. Their
sappearance (straightening and compression of the column) com-
ences at points of high gas density (near the anode or cathode
pending on the conditions of the experiment).

537.525.6 : 539.17
79. THE ELECTRON TEMPERATURE IN SCEPTRE III.
Kaufman and R.V.Williams.
ture (London), Vol. 182, 557-8 (Aug. 30, 1958).
From a preliminary measurement of the absolute intensity of
C (V) 2770.9 A line, the electron temperature is estimated to be
5×10^5 °K to within a factor of 2. R.S.Pease

537.525.8 : 621.387
80. NOISE AND ELECTRON TEMPERATURES OF SOME
OLD CATHODE ARGON DISCHARGES. E.W.Collings.
appl. Phys., Vol. 29, No. 8, 1215-19 (Aug., 1958).
Noise temperatures at 3000 Mc/s were compared with the
rresponding electron temperatures for the positive columns of
me cold-cathode discharges in argon. The noise temperatures
re measured using a superheterodyne receiver of low-noise figure,
comparing the noise outputs of the various tubes with that from a
mmercial fluorescent lamp of measured noise output, a rapid com-
rison between known and unknown noise powers being effected by
eans of a hand-operated waveguide switch. The noise temperature
the fluorescent lamp in its mounting was measured by comparison
th an absolute standard consisting of an incandescent tungsten
ament lamp fitted in a suitable waveguide holder. Electron tem-
ratures were measured by the Langmuir single-probe method. It
is concluded that for most of the tubes measured, noise temperature and electron temperature are in close agreement as required by the theories.

537.529 : 536.422

ELECTRICAL EXPLOSION OF SPIRAL WIRES IN VACUUM. See Abstr. 2267

X-RAYS

537.531 : 535.331

2381. CHARACTERISTIC MULTIPLETS IN THE X-RAY EMISSION SPECTRA OF ERBIUM. P.Sakellaridis.
C.R. Acad. Sci. (Paris), Vol. 247, No. 13, 921-3 (Sept. 29, 1958). In French.

The multiplet structure of Er_2O_3 reported here is consistent with an incompletely filled 4f-subshell. J.R.Mallard

537.531 : 535.33

2382. ON THE PRODUCTION OF CONTINUOUS X-RAYS AT AN INTERNAL ANTI-CATHODE OF A BETATRON.
G.Harigel, H.Kulenkampff, M.Scheer and J.Seyerlein.
Naturwissenschaften, Vol. 45, No. 21, 508-9 (1958). In German.

The distribution of the continuous X-ray spectrum produced in a platinum target by 30 MeV electrons has been studied in a betatron. Experimental difficulties are discussed. The experimental results are in good agreement with calculated values.
A.E.I. Research Laboratory

537.531 : 535.33

2383. ENERGY DISTRIBUTION IN THE SPECTRUM OF THE CONTINUOUS X-RADIATION OF A 35 MeV BETATRON.
H.Kulenkampff, M.Scheer, E.Schrüfer and J.Seyerlein.
Naturwissenschaften, Vol. 45, No. 21, 509 (1958). In German.

The energy distribution in the spectrum of continuous X-radiation from a platinum target was measured by means of a magnetic Compton spectrometer. A 35 MeV betatron was used as a source of electrons and the target was a cylinder of 2 mm diameter. The experimental results agree well with those calculated, provided allowance is made for energy losses of the electrons in the target. Some results are also given for aluminium targets.
A.E.I. Research Laboratory

537.531 : 535.43

2384. CALCULATION OF THE TRANSMISSION FACTOR IN X-RAY SCATTERING. M.Sawada and C.H.Shaw.
J. appl. Phys., Vol. 29, No. 9, 1344-7 (Sept., 1958).

Analytical equations were derived for the transmission factor applicable to the case of a rather weakly absorbing sample of circular cross-section and larger than the X-ray beam. Calculations are presented for liquid nitrogen and it is shown that under certain practicable conditions the transmission factor is constant for a rather wide range of the scattering angle.

537.531 : 545.824

2385. SOME METHODS FOR ANALYSING UNRESOLVED PROPORTIONAL COUNTER CURVES OF X-RAY LINE SPECTRA.
R.M.Dolby.
Proc. Phys. Soc., Vol. 73, Pt 1, 81-94 (Jan., 1959).

Three different pulse analysis methods are described by which the intensities of several closely spaced spectral lines, as detected by a proportional counter, may be determined quickly and unambiguously. The techniques are applicable where each significant line occurring in the spectrum can be obtained separately for calibration procedures; X-ray emission microanalysis, for example, fulfils this condition. The two methods which were tested gave absolute errors in the order of a few per cent in analysing various mixtures of copper and nickel. An important application of such techniques is in the analysis of characteristic X-rays having long wavelengths and low intensity, since maintenance of an adequate counting rate under these conditions is difficult if a crystal or ruled grating spectrometer is used.

537.531 : 535.33.07

2386. SOFT X-RAY SPECTROSCOPY USING AN ELECTRON MULTIPLIER. J.A.Catterall, L.F.Wilson and J.Trotter.
J. sci. Instrum., Vol. 35, No. 11, 393-5 (Nov., 1958).

The modification to a soft X-ray spectrograph in order to use an electron multiplier instead of a photographic plate is described. The instrument has been calibrated with the aluminium and magnesium L_{23} spectra.

537.531 : 535.33.07 : 545.824

2387. X-RAY SPECTROGRAPHS FOR RAPID X-RAY FLUORESCENCE ANALYSIS WITH PHOTOGRAPHIC RECORDING.

E.F.Priestley.

J. sci. Instrum., Vol. 35, No. 11, 409-13 (Nov., 1958).

Curved crystal spectrographs are described covering the range from potassium to uranium. With the lighter speed model simultaneous recording of spectra between 0.5 to 2.5 A or 1.5 to 3.75 A is possible and minor constituents at the 0.1% level can be detected. A higher sensitivity version (down to 0.001%) employs a scanning device for covering the required wavelength range. With suitable comparison standards the instruments may be used for quantitative as qualitative analysis.

537.531 : 535.33.07 : 539.1.07

2388. THE RESOLUTION CORRECTION IN THE SCINTILLATION SPECTROMETRY OF CONTINUOUS X-RAYS.

W.R.Dixon and J.H.Aitken.

Canad. J. Phys., Vol. 36, No. 12, 1624-33 (Dec., 1958).

In the scintillation method for the measurement of continuous X-ray spectra, the incident X-rays are absorbed in a light-producing crystal, chosen so that the intensity of the light flashes is proportional to the energy absorbed. A photomultiplier converts the light flashes into voltage pulses, which are then amplified and analysed as to height in a kicksorter. Analytical solutions are given to the integral equation which described the effect of the statistical spread in pulse height. The practical necessity of making some kind of numerical analysis is pointed out. Difficulties with numerical methods arise from the fact that the observed pulse-height distribution cannot be defined precisely. As a result it is possible in practice only to find smooth "solutions". Additional difficulties arise if the numerical method is based on an invalid analytical procedure. For example matrix inversion is of doubtful value in making the resolution correction because there does not appear to be an inverse kernel for the integral equation in question.

537.531 : 535.33.07 : 545.824

2389. THE EFFECT OF VARIATIONS IN AMBIENT TEMPERATURE UPON THE OPTICAL ALINEMENT OF AN X-RAY FLUORESCENCE SPECTROMETER. T.A.Davies.

J. sci. Instrum., Vol. 35, No. 11, 407-9 (Nov., 1958).

During proving tests made on an X-ray fluorescence spectrometer, it was foundly that variations in ambient temperature produced a significant effect upon the dispersion of the instrument. Experimental evidence indicated that this was due to changes in the interplanar spacing of the diffracting crystal. The magnitude of the effect is shown to be in good agreement with theoretical considerations. Since the angular dispersion is an inverse function of $d \cos\theta$, the effect is most marked at high Bragg angles. The significance of the observed changes in angular dispersion, in relation to the accuracy of analysis, is pointed out.

ELECTRON EMISSION . ELECTRON BEAMS

537.533 : 621.385.833

2390. CURRENT DISTRIBUTION IN MODULATED MAGNETICALLY FOCUSED ELECTRON BEAMS.

M.Chodorow, H.J.Shaw and D.K.Winslow.

J. appl. Phys., Vol. 29, No. 11, 1525-33 (Nov., 1958).

Detailed measurements have been made of the d.c. and r.f. current distribution in a modulated, magnetically focused electron beam having normalized parameters in the range of values appropriate for practical medium-power and high-power klystrons. The ratio of the total r.f. current to the total d.c. current in the beam as a function of drift distance was determined experimentally under Brillouin-flow conditions for selected values of α (the ratio of the r.f. voltage at the input gap to the d.c. beam voltage). These experimental values are compared with the results predicted theoretically. Similar experimental results are presented for higher focusing fields. Detailed radial distributions of the d.c. and r.f. current were experimentally determined by using an iris (a plate with a small hole) to allow only a small portion of the beam to be selected at any radial position. These measurements were made at various values of α and drift distance. The results for small values of α show, as predicted by theoretical considerations for a modulated Brillouin-flow beam, that the radial r.f. current distribution in the beam is the same as that of a beam whose modulation is represented as sinusoidal scallops on a beam of constant (volume) charge density. As either α or the focusing field, or both, are increased, the r.f. current is no longer confined to the beam periphery but becomes more evenly distributed throughout the beam cross-section.

537.533 : 621.385.833

2391. DYNAMICS OF ELECTRON BEAMS FROM MAGNETICALL SHIELDED GUNS. A.Ashkin.

J. appl. Phys., Vol. 29, No. 11, 1594-604 (Nov., 1958).

The electron orbits and beam shape variations are investigated with an electron beam analyser which measures current density variations and transverse velocity. The existence of rings of charge that move through the beam and the gradual reduction in beam scalloping with length are demonstrated. It is shown that simple energy considerations plus an account of the role of transverse thermal velocities is sufficient to account for the experimentally observed features of beam behaviour in the limit of negligible space charge. In the presence of space charge the beam behaviour is qualitatively unchanged except for some defocusing and precession of the electro orbits provided that the magnetic field is at least several times the Brillouin field.

537.533 : 621.385.833

2392. NEW MECHANISM OF NOISE REDUCTION IN ELECTRON BEAMS. M.R.Currie and D.C.Forster.

J. appl. Phys., Vol. 30, No. 1, 94-103 (Jan., 1959).

Experiments have demonstrated that the basic noise quantities of an electron beam can be transformed and optimized by varying the field configuration and flow characteristics in the multivelocity region near the cathode. Tube noise figures as low as 2.9 dB and numerical values of beam noisiness $2\pi/kT_c(S-\Pi) < 0.27$ have been attained at microwave frequencies (S band). A detailed investigatio of the conditions for minimum beam noisiness is presented. The beam is injected from the edge of the cathode into a highly divergent electric field and results in a distorted potential profile which grea ly extends the low-velocity region below $\frac{1}{2}$ V. It is shown that these features satisfy the physical conditions necessary for realizing a quasi-one-dimensional model in which the transforming properties of a "multivelocity noise transducer" can be adjusted by varying the rate of acceleration through this region. The experiments also suggest other models and possible approaches for further theoretical and experimental investigation.

537.533 : 621.385.

2393. SPACE CHARGE NEUTRALIZATION BY POSITIVE IONS IN DIODES. P.L.Auer and H.Hurwitz, Jr.

J. appl. Phys., Vol. 30, No. 2, 161-5 (Feb., 1959).

The neutralization of electron space charge in diodes is analyse on the basis of the assumption that the ion density is proportional t $e^{-eV/kT}$, where V is the local potential and T is the cathode temperature. The neglect of electron—ion collisions enables solutions for the potential variation between electrodes to be obtained by a single numerical quadrature. Curves are presented for the potentia as a function of position for a series of values of the ratio α of ion to electron density at the potential minimum. It is shown that for a large range of tube parameters, the electron current reaches two-thirds of its saturated value when the ion density at the cathode is about one-third the quantity I_s/ev_0, where I_s is the saturation curre and $v_0 = (2kT/\pi m)^{\frac{1}{2}}$. The electron current saturates completely whe the ion density at the cathode is slightly above 0.81 I_s/ev_0 for large electrode spacing and slightly below I_s/ev_0 for small spacing. The anomalous behaviour of the potential as a function of position when α lies between 0.81 and unity leads to the possibility of more than one mode of operation for a given ion density at the cathode and als causes the tube current to increase rather than decrease with incre sing electrode spacing under certain conditions. Since these phenomena occur only over a narrow range of tube parameters, the effect of electron—ion collisions may prevent them from being observed experimentally.

537.533 : 621.385.8

537.533 : 621.385.833

2394. THE RELATIVISTIC FLOW OF ELECTRONS IN PARALLE AND RADIAL STRAIGHT LINES WITH NO EXTERNALLY IMPOSE MAGNETIC FIELD. A.R.Lucas.

J. Electronics and Control, Vol. 5, No. 3, 245-50 (Sept., 1958).

Four cases of rectilinear dense flows are considered: a parall "ribbon" beam, a parallel beam of cylindrical symmetry, a beam radiating virtually from a point, and a beam radiating virtually fro a straight line. A rigorous treatment, taking into account both the relativistic mass and the self-magnetic field, shows that these flow would not be generated from a space-charge-limited cathode. The proof includes the general theorem that electrons from a space-charge-limited cathode must leave it at right angles. B.Meltzer

537.533

2395. MAGNETIC PERTURBATION OF CATHODE RAYS.
J.Yamaguchi.
Nuovo Cimento, Vol. 10, No. 4, 714-17 (Nov. 16, 1958).

When an electron beam penetrates a magnetized body, splitting of the electron beam occurs. This phenomenon is explained in terms of polarization of the cathode rays.

537.533 : 621.385.833

2396. STUDIES ON THE ANOMALOUS NOISE IN MAGNETICALLY FOCUSED ELECTRON BEAMS. H.P.Louis.
Tech. Mitt. P.T.T., Vol. 36, No. 9, 333-48 (1958). In German.

Describes an experimental study on the noise production in Brillouin beams, i.e. beams formed by the use of a sudden increase in magnetic field from zero. The anomalous increase in noise is due to scalloped beam amplification. The effect of space charge is eventually to return the beam to thermal equilibrium. For a similar study see Abstr. 6303-4B (1957); Bell Syst. tech. J., Vol. 36, No. 4, 31-53, 855-78 (July, 1958). A.H.W.Beck

537.533.1 : 539.1.07

2397. MEASUREMENT OF ELECTRON BEAM ENERGY USING A GAS ČERENKOV DETECTOR.
M.R.Bhiday, R.E.Jennings and P.I.P.Kalmus.
Proc. Phys. Soc., Vol. 72, Pt 6, 973-80 (Dec., 1958).

It is shown that the energy of a monoenergetic beam of fast electrons can be accurately determined by using a variable-pressure gas Cherenkov detector. A description of a simple detector of this type, and results taken with a 4.5 MeV electron beam, are given.

537.533.2 : 537.58

2398. MODEL FOR THE SURFACE POTENTIAL BARRIER AND THE PERIODIC DEVIATIONS IN THE SCHOTTKY EFFECT.
P.H.Cutler and J.J.Gibbons.
Phys. Rev., Vol. 111, No. 2, 394-402 (July 15, 1958).

Although most of the features of the observed periodic deviations in the Schottky effect are in good agreement with predicted behaviour, there is still disagreement between theory and experiment in the phase and amplitude of the deviations. It has been suggested that a possible origin of this difficulty is the use of the simple image force barrier at the surface of the metal. In this paper a model for the surface potential barrier is developed which is based on the quantum-mechanical calculation made by Bardeen on the form of the potential at the surface of a sodium-like metal, and the analysis of Sachs and Dexter on the quantum limits of the image-force theory. Employing this model, the periodic deviations are recalculated using essentially the mathematical formalism developed by Juenker and his co-workers. Certain computational refinements are introduced in the averaging of the transmission coefficient. The results are compared with previous theory and experiment in terms of two parameters which characterize the form of the surface potential; the surface reflection coefficient $|\mu|$ which appears as a factor in the amplitude, and the phase factor δ. These computed values are 0.6 and 2.6 respectively, as compared with single mean experimental values of 0.4 and 2.2 for the highly refractory metals, and with previous theoretical values of 0.2 and 3.7. The surface reflection coefficient calculated for the present model is in satisfactory agreement with recent experiments on the elastic scattering of slow electrons from the surface of a metal.

537.533.2 : 621.383.27

2399. TRANSMISSION SECONDARY ELECTRON MULTIPLICATION FOR HIGH-SPEED PULSE COUNTING.
E.J.Sternglass and M.M.Wachtel.
I.R.E. Trans Nuclear Sci., Vol. NS-3, No. 4, 29-32 (Nov. 1956).

A new type of high-speed electron multiplier employing transmission secondary electron emission from thin insulating films is described. Electrons from a photosurface are multiplied in a series of plane-parallel dynodes consisting of a thin scattering layer of a heavy metal followed by a layer of a pure crystalline insulating material of high secondary emission yield. The characteristics of such dynodes are described, and the d.c. and pulse performance of an experimental seven-stage device employing this principle is presented.

537.533.2 : 621.383.27

2400. RECENT DEVELOPMENTS IN MULTIPLIER PHOTO-TUBES. B.R.Linden.
I.R.E. Trans Nuclear Sci., Vol. NS-3, No. 4, 33-5 (Nov., 1956).

537.533.2 : 539.18

2401. LIBERATION OF ELECTRONS BY FAST NEUTRAL HELIUM ATOMS FROM A TUNGSTEN TARGET. H.W.Berry.
J. appl. Phys., Vol. 29, No. 8, 1219-25 (Aug., 1958).

The electron emission from tungsten by bombarding helium atoms of energy ranging from 300 to 3500 eV was measured for a surface with less than a monolayer and with multilayers of adsorbed gas. The yield expressed in electrons per particle rises almost linearly from about zero at 300 eV to 0.42 electrons/particle at 3500 eV for a monolayer of adsorbed gas. Further adsorption of gas gives a much increased yield. These yields are compared with the ion under like conditions. The distributions of the normal velocity and a component of the tangential velocity are compared for the ion and neutral atom on hot and cold targets.

537.533.2

2402. THE PROBABILITY OF MULTIPLE EMISSIONS OF SECONDARY ELECTRONS. R.E.Barrington and J.M.Anderson.
Proc. Phys. Soc., Vol. 72, Pt 5, 717-26 (Nov., 1958).

Probabilities P_n were determined for the emission of electrons in groups of n numbering from zero to eight occurring as a result of a single primary. Beryllium—copper alloy surfaces under different activation conditions were studied for primary energies between 100 and 300 eV, P_0, having values between 0.5 and 0.2 falling to a minimum at intermediate energies, and P_1, with values 0.3 to 0.4 rising to a maximum at intermediate energies, remain larger than any other probability. Probabilities above P_1 for constant primary energy fall off with number in two distinct curves, that for even numbers lying above and falling less steeply than that for odd numbers. Separation of these curves depends on surface treatment. For activated surfaces probabilities P_1 to P_6 show evidence of maxima in the energy range covered; P_7 and P_8 are still rising at the end of the range. For unactivated surfaces only P's for odd numbers of electrons show a clear decrease at higher energies; P's with for even numbers of electrons, with the possible exception of P_2, are still rising at the end of the range.

537.533.2

2403. THE TIME CONSTANT FOR SECONDARY EMISSION.
H.W.Streitwolf and W.Brauer.
Z. Naturforsch., Vol. 13a, No. 8, 700-1 (Aug., 1958). In German.

A new calculation of the time elapsing between the arrival of the primary and the emission of the secondary radiation. The order of magnitude is 10^{-15} sec. A.H.W.Beck

537.533.3 : 537.534.3

2404. APPLICATION OF MAGNETIC SLITS IN THE PRODUCTION OF CIRCULAR PARTICLE TRAJECTORIES.
V.M.Kel'man, V.A.Kolyunov and M.V.Karpov.
Zh. eksper. teor. Fiz., Vol. 35, No. 5(11), 1113-15 (1958). In Russian.

An electron-optical system consisting of magnetic slits arranged in a circle is proposed which can be employed to obtain almost circular charged-particle trajectories. The magnetic field strength in such a system rapidly increases with the distance from the axis but this does not lead to defocusing in the vertical direction. Thus a system of this type can be employed in an accelerator with a constant guiding field. The path of an electron beam during its first circuit in the system under consideration was studied experimentally.

537.533.332

2405. ON THE IMAGING DEFECTS OF ARBITRARILY BOUNDED HOMOGENEOUS MAGNETIC SECTOR FIELDS.
L.A.König and H.Hintenberger.
Z. Naturforsch., Vol. 12a, No. 5, 377-84 (May, 1957). In German.

As an extension of earlier work on the particle-deflecting properties of magnetic sector fields with straight boundaries, the properties of such fields with curved boundaries are studied. Expressions are given for aberrations, and it is shown that at least some of these can be removed by suitable choice of boundary curvature. A.E.I. Research Laboratory

537.533.35 : 539.27

2406. GRAPHICAL METHOD FOR ESTIMATION OF CONTRAST IN ELECTRON MICROSCOPY. P.Sadhukhan.
J. appl. Phys., Vol. 29, No. 8, 1235-7 (Aug., 1958).

In the preparation of shadowed specimens for electron microscopic examination, it is often required to estimate the contrast to be expected with different thicknesses of films of various metals, different aperture angles, and beam potentials. A graphical method is described for this purpose.

537.533.35

2407. THE SPACE-CHARGE ABERRATION AND THE RESOLVING POWER OF THE ELECTRON MICROSCOPE. W.E.Meyer.
Optik, Vol. 15, No. 7, 398-406 (July, 1958). In German.

The aberration due to space charge is calculated in conditions typical of electron microscopy, under certain simplifying assumptions. When the aperture of the illuminating beam α_L is equal to that of the objective α_0, the only effect is a shift of focus. If the illuminating aperture is smaller than that of the objective, as is usual, the strength of the outer zones of the lens is weakened less than that of the inner zones, i.e. an effect in the same sense as a spherical aberration. An integral expression is obtained for the effect on the focal length, and is evaluated for the simple case of uniform current density in any cross-section of the beam; thus, the actual space-charge error will be rather greater than that calculated. For typical conditions of high-resolution operation of the magnetic electron microscope, it is found that the error rises sharply with angle, above the value of α_L. It is approximately proportional to α/α_L, and would amount to 5 or 6 A in conditions in which the resolution limit due to spherical aberration and diffraction would be 3.5 A. In the electrostatic microscope, its value is calculated to be 14-15 A when the resolution limit should be 10 A. The space-charge effect is therefore a limiting factor in practical conditions of electron microscopy, contrary to the conclusions of Grumm (Abstr. 2481/1952), who considered only the external rays of the imaging beam. The space-charge error can be reduced to negligible proportions by using lower current density (longer exposure), smaller area of illumination in the object plane, or by arranging for the current density in the incident beam to increase with radius. In principle, the last method could be utilized for correcting the spherical aberration of the lens. Experimental tests showed that the resolution of an electrostatic electron microscope was appreciably improved by reducing the current density to about one-tenth of that normally used. Micrographs are reproduced having a resolving power of 15 A, equal to that calculated from the known spherical and chromatic aberration of the objective lens; this is the first time that the theoretical limit of an electrostatic system has been reached in practice. V.E.Cosslett

537.533.35

2408. THE COMBINED EFFECT OF PHASE AND AMPLITUDE CONTRAST IN ELECTRON MICROSCOPE IMAGE FORMATION.
F.Lenz and W.Scheffels.
Z. Naturforsch., Vol. 13a, No. 3, 226-30 (March, 1958). In German.

The dependence of contrast in an electron microscope image on the amount of defocusing is calculated for the case of two simple object models: a linear strip, and two strips separated by a distance of the same order as their width. They are illuminated by a plane electron wave, which is changed in both amplitude and phase in passing through them, i.e. they possess a finite scattering cross-section and finite refractive index for electrons. The distribution of current density in any plane behind the object is found from the Kirchoff diffraction expression, using the Cornu spiral. As in the previously investigated case of an object with sinusoidal variation of refractive index (von Borries and Lenz, Proceedings of the Electron Microscopy Conference, Stockholm, 1956, p. 60), a plane of maximum contrast is found to exist behind the object, which will give an image of maximum contrast when the objective lens is defocused correspondingly. The degree of contrast depends on the amount of phase shift which occurs. In the case of two parallel strips, a spurious periodicity appears in the image as defocusing proceeds. The results agree in their main features with a through focal series of electron micrographs of nerve fibres taken by Gansler and Nemetschek (Z. Naturforsch., Vol. 13b, 190, 1958). Similar spurious structures were obtained by the authors by defocusing an optical microscope used to view a line grating at very small numerical aperture. The bearing of these findings on recent work on the electron microscopy of crystal lattices is briefly discussed. V.E.Cosslett

537.533.35 : 539.165.07

2409. A PROLATE SPHEROIDAL FIELD MAGNETIC SPECTROMETER WITH SOURCE NEAR THE EQUATORIAL PLANE.
P.R.Evans, N.J.Freeman, G.K.McGinty, B.H.Armitage and H.O.W.Richardson.
Proc. Phys. Soc., Vol. 72, Pt 6, 949-58 (Dec., 1958).

A prolate spheroidal field β-spectrometer is described in which the source and detector are located on the same side of the focal ring slit. The trajectories reach distances of up to 38 cm from the axis and the ring slit has a radius of 33 cm. The relation between the resolution and transmission was measured for four source diameters. Using a scintillation detector of 1.85 cm diamet and 1 cm length, a resolution of W of 1.28% at a transmission of T of 1% of 4π was found for a source of 1 cm diameter. For a 1 m source the measured values range from W = 0.4% at T = 0.8% to W = 1.52% at T = 5.2%.

537.533.7

2410. MULTIPLE SCATTERING OF 600 MeV ELECTRONS IN THIN FOILS. R.F.Mozley, R.C.Smith and R.E.Taylor.
Phys. Rev., Vol. 111, No. 2, 647-9 (July 15, 1958).

The beam of the Stanford Mark III linear accelerator was used to measure the width of the angular distribution of electrons multiply scattered in thin Be, Al, and Au foils. The results are in agreement with the predictions of the Molière theory.

537.533.8

2411. THE HIGH-ENERGY END OF THE ELECTRON-BREMSSTRAHLUNG SPECTRUM. M.V.Mihailović.
Nuovo Cimento, Vol. 9, No. 2, 331-3 (July 16, 1958).

This is an outline of a calculation based on the Sommerfeld—Maue approximation and expected to be satisfactory except for heav nuclei. W.A.Hepner

ION EMISSION . ION BEAMS

537.534

2412. METHOD OF CANCELING ENERGY FLUCTUATIONS OF A VAN DE GRAAFF ION BEAM.
P.B.Parks, H.W.Newson and R.M.Williamson.
Rev. sci. Instrum., Vol. 29, No. 10, 834-9 (Oct., 1958).

A varying correction voltage is applied to the target which cancels beam energy fluctuations. This correction voltage is a known, constant multiple of a small, variable voltage which must be applied to the outer plate of an electrostatic analyser to keep the beam centred at the analyser image slits. The beam current at the analyser image slits provides the signal which, when amplified by an electronic device called the homogenizer, drives both the outer analyser plate and the target. The energy spread is reduced to 250 ± 120 eV and is probably due only to the ion source. If the HH^+ beam is put through the analyser, the unlimited H^+ beam also has an energy spread of 250 eV. The 1.76 MeV $C^{13}(p,\gamma)$ and 0.992 MeV $Al^{27}(p,\gamma)$ resonances were used to test performance. The present data are consistent with $\Gamma(C^{13}) = 75$ eV and $\Gamma(Al^{27}) = 100$ eV. The upper limit for the C^{13} width is 150 eV.

537.534

2413. MASS SPECTROMETER ION SOURCE FOR SOLID SAMPLES. B.R.F.Kendall.
Rev. sci. Instrum., Vol. 29, No. 12, 1089-92 (Dec., 1958).

A single-filament positive ion source for solid samples is described. The source is simple and compact. Heat dissipation is low. Isotopic fractionation effects are very much smaller than is the case with conventional single-filament surface ionization sources The main ionization process occurring in the source is considered to be the surface ionization of the sample vapour on the tungsten filament. The sample vapour is maintained at a comparatively high pressure inside the source assembly. Investigations are described which indicate that other possible emission processes do not contribute any significant proportion of the emitted ion beam. Variations in the measured relative isotopic abundance ratio K^{39}/K^{41} during a run to exhaustion of the sample are discussed. There is no significant ratio trend with time and the random fluctuations of the measured ratio are such that more than half of the values are within 0.2% of their mean. The mean values can be repeated with a probable error which is less than about 0.3%.

537.534

2414. INVESTIGATIONS ON A HIGH-FREQUENCY ION SOURCE.
R.Hölz and H.Löb.
Z. Naturforsch., Vol. 13a, No. 8, 602-8 (Aug., 1958). In German.

A high-frequency ion source was built in which ions are extracted, accelerated by an electrostatic lens and analysed by a 60° sector field spectrometer. With this apparatus optimal operating conditions were investigated. The ions that leave the source with practically thermal energies were specifically observed.

A.E.I. Research Laboratory

537.534

2415. A NEW METHOD OF PLASMA GENERATION FOR USE IN ION SOURCES. A.Ziegler.

Z. angew. Phys., Vol. 10, No. 4, 185-6 (April, 1958). In German.

Briefly describes a "plasma jet" device for ion sources. Yield figures, pressures, etc. are given, with a sketch of the apparatus.

J.D.Craggs

537.534

2416. SECONDARY POSITIVE ION EMISSION FROM METAL SURFACES. R.C.Bradley.

J. appl. Phys., Vol. 30, No. 1, 1-8 (Jan., 1959).

Secondary positive ions ejected from surfaces of Mo, Ta, and Pt under bombardment by inert gas ions of low energy (< 1000 eV) were studied in high vacuum ($\leq 10^{-8}$ mm of Hg of background gases) using a 60° sector field mass spectrometer with a 6 in. radius of curvature, the object being to explore this as a technique for investigating solid surfaces in general. Ion species characteristic of the base metal, of surface compounds, and of a few bulk impurities were found. Quantitative analyses based on abundance ratios of the ions are unreliable, however owing to the enormous and essentially unknown differences in ionization efficiencies for the various species. Application of the technique to the investigation of surface kinetics seems highly promising, and as an illustration certain observations on the formation of PtO_3 on a Pt surface and its desorption at high temperatures are presented. Another possible application is to the study of sputtering, although some of the properties of secondary ions are shown to be quite different from those of sputtered particles in general. The secondary ions characteristic of the base metal comprise only a small fraction (0.01% for Pt) of the total sputtering yield, are principally singly charged and monatomic, have a low average energy (4-5 eV) and energy spread, and may result either from physical sputtering of the base metal or from the dissociation of surface compounds or both.

537.534.3

2417. LENS EQUATION AND IMAGE CURVE OF A CYLINDRICAL CONDENSER WHEN THE ENTRY AND EXIT OF AN ION BEAM IS OBLIQUE AT FIELD BOUNDARIES. H.Wende.

Z.Naturforsch., Vol. 12a, No. 12, 967-70 (1957). In German.

The ion-optical lens equation (Herzog, Abstr. 3859/1934) is extended to the case of oblique entry and exit, using the theory of second approximation. The position of the image curve and the properties of an "energy spectrograph" are discussed.

F.Lachman

537.534.3

2418. ON MASS-SPECTROMETERS WITH PERFECT DOUBLE-FOCUSING OF THE SECOND ORDER.

H.Hintenberger and L.A.König.

Z. Naturforsch., Vol. 12a, No. 5, 443 (1957). In German.

Some examples of design data for a double-focusing mass-spectrometer free from second-order aberrations are given; they were obtained by solution of the five equations given in the authors' previous paper (see Abstr. 348/1959).

B.Meltzer

537.534.3

2419. ADJUSTMENT OF MASS SPECTROGRAPHS.

F.Everling and H.Wende.

Z. Naturforsch., Vol. 12a, No. 12, 971-3 (1957). In German.

It is proved, for the Mattauch—Herzog mass spectrograph, that a small deviation in the dimensions of a mass spectrograph from those calculated according to the general theory of Mattauch—Herzog can be compensated by suitable adjustment. The relevant equations are given and a systematic method of adjustment is described.

F.Lachman

537.534.3

2420. MASS SPECTROMETER WITH PULSED ION SOURCE.

E.I.Agishev and N.I.Ionov.

Zh. tekh. Fiz., Vol. 28, No. 8, 1775-88 (1958). In Russian.

Theoretical discussion of the principles of operation of an instrument described in a previous paper (Abstr. 468/1957). The conditions for obtaining the best resolving power and focusing are investigated. A further set of experimental data, obtained using a laboratory model, are given and discussed, together with suggestions to improve the design for industrial purposes.

G.Martelli

537.534.9

2421. THEORY OF SPUTTERING BY HIGH-SPEED IONS.

D.T.Goldman and A.Simon.

Phys. Rev., Vol. 111, No. 2, 383-6 (July 15, 1958).

The theoretical treatment of ion sputtering at energies above about 50 keV is simplified by the fact that the emergent particles originate at depths in the material which are small compared to the range of the incident particles. The displacement rate is nearly constant over this region and this enables one to obtain relatively simple solutions of the diffusion problem for emission. The emission problem is reduced to an effective one-velocity diffusion calculation by an artifice. The volume displacement is increased by the factor $\bar{\nu}$, where $\bar{\nu}$ is the average number of secondaries, and the macroscopic absorption and scattering cross-sections are adjusted to make the average number of collisions of each particle equal to the actual average over the secondaries. The resultant sputtering ratio, $\mathfrak{R}$, varies with incident energy E, incident angle Ψ, and mass ratio $\mu = M_1/M_2$ (where M_1 = mass of incident particle, M_2 = mass of target particle), as $\mathfrak{R} \propto \mu(\ln E/E) \sec \Psi$.

PARTICLE ACCELERATORS

537.54

2422. THE MULTIPACTOR EFFECT IN A LINEAR ELECTRON ACCELERATOR. V.J.Vanhuyse, J.L.Verhaeghe and J.Turf.

Nuovo Cimento, Vol. 10, No. 4, 721-7 (Nov. 16, 1958).

Phenomena, due to the multipactor effect, observed in the linear electron accelerator of the Ghent University are reported. An explanation is proposed for the variation of the anomalous attenuation due to the multipactor effect as a function of the r.f. power fed in the accelerator.

537.54

2423. THE 31 MeV BETATRON. A.Peterlin.

"J. Stefan" Inst. Rep., Vol. 2, 53-9 (May, 1955). In German.

This machine is used for both medical work and physical research. The distribution of radiation dose was measured in the machine and observation rooms. Measurements were also made of the energy and temporal distribution of the radiation and of the neutron background.

D.H.Lord

537.54

2424. ON THE THEORY OF THE LINEAR BETATRON.

M.V.Konjukov and J.P.Terletskij.

Nuovo Cimento, Vol. 9, No. 6, 930-41 (Sept. 16, 1958).

Three cases of electron motion in an axially symmetric magnetic field displacing along the axis are discussed: (1) the magnetic field is displacing in such a manner that the electron orbit radius remains constant; (2) the magnetic field is displacing uniformly with constant velocity $u < c$; (3) the magnetic field is displacing with light velocity c. The gained energy, the time and path of acceleration are calculated for each of the three cases.

537.54

2425. ON THE CAPTURE MECHANISM AND LIMITING CURRENT IN BETATRONS. A.N.Matveev.

Zh. eksper. teor. Fiz., Vol. 35, No. 2(8), 372-80 (1958). In Russian.

The mechanism of electron capture in a betatron is considered by taking into account Coulomb interaction of the electrons in the beam and electron losses on the walls of the vacuum chamber. The problem can be solved completely for a simplified model. It is found in this case that the mechanism under consideration should be highly effective, a result which is in agreement with experiment. A formula for the limiting current is presented which is also valid for relativistic electron energies.

537.54 : 539.12

2426. COHERENT RADIATION OF ELECTRONS IN A SYNCHROTRON. I. L.V.Iogansen and M.S.Rabinovich.

Zh. eksper. teor. Fiz., Vol. 35, No. 4(10), 1013-16 (1958). In Russian.

The potential of the radiation field of a single relativistic electron moving in a circle and simultaneously excuting small phase oscillations is investigated. A general expression for the spectrum of the radiation field potential of a bunch was obtained with the aid of the potential of a single phase-modulated electron and of the distribution function of the particles in the bunch. The expression is valid for sufficiently low harmonics for which the radiation is coherent.

537.54
2427. ON CYCLIC ACCELERATION OF PARTICLES IN HIGH-FREQUENCY FIELDS. V.I.Veksler and L.M.Kovrizhnykh.
Zh. eksper. teor. Fiz., Vol. 35, No. 5(11), 1116-18 (1958).
In Russian.

The feasibility of employing high-frequency fields for controlling the motion of particles in orbital accelerators is demonstrated.

537.543 : 539.1.07
2428. CYCLOTRON BEAM INTENSITY MEASUREMENTS.
S.Amiel and N.T.Porile.
Rev. sci. Instrum., Vol. 29, No. 12, 1112-15 (Dec., 1958).

A Faraday cup and target assembly for the determination of cross-sections for nuclear reactions induced by charged particles from a 60 in. cyclotron is described. Independent checks and calibrations on the performance of the assembly were carried out. The conditions affecting the operation of this assembly are discussed. Cross-sections for two standard alpha-induced reactions are given.

IONIZATION . PLASMA

537.56
2429. THEORY OF EXCITED PLASMA WAVES. M.Sumi.
J. Phys. Soc. Japan, Vol. 13, No. 12, 1476-85 (Dec., 1958).

The excitation of oscillations in a uniform plasma by an injected electron beam is considered. The dispersion relation for this system is derived by means of Fourier—Laplace transform method. The solutions of the dispersion relation are obtained which yield the characteristics of excited waves: the frequency, the phase-velocity and the time-rate of wave-growth as functions of the wave number. It is demonstrated that the wave characteristics are varied by the influence of thermal velocity of electrons in the main plasma and by taking the ratio of electron density in the beam to that in the main plasma over a wide range of values. It is then shown that both the velocity spread in the beam and collisions in the medium have the decaying effect on the growing wave. The case is also discussed in which the main plasma is bounded by ideally thin sheaths.

537.56
2430. CURRENT—VOLTAGE BEHAVIOUR IN A PLASMA.
L.Gold.
J. Electronics and Control, Vol. 5, No. 5, 432-4 (Nov., 1958).

Previously an approximate solution to the current—voltage behaviour in plasma oscillations had been given (Abstr. 5135/1958). Now an exact solution is derived. It is a rather complex relation which needs numerical analysis. D.Walsh

537.56
2431. AN INVESTIGATION ON PLASMAS IN EXTERNAL MAGNETIC FIELDS. I. STEADY STATE. G.Schmidt.
Nuovo Cimento, Vol. 10, No. 1, 55-67 (Oct. 1, 1958).

The stationary state of a magnetically confined neutral plasma is investigated. For a rare plasma, without particle collisions a method is developed by which a complete set of plasma equations is established. This is based upon the simultaneous solution of Maxwell's equations and the equations of the particles. As application of this method, generalized forms of the pressure balance equations are derived. An alternative treatment of this relation on the basis of the Boltzmann equation leads to a general expression, valid also for cases when collisions are not negligible. As an example the plasma equations are solved for a problem, for which the usual first order theory breaks down.

537.56
2432. PHOTODETACHMENT CROSS-SECTION AND THE ELECTRON AFFINITY OF ATOMIC OXYGEN.
L.M.Branscomb, D.S.Burch, S.J.Smith and S.Geltman.
Phys. Rev., Vol. 111, No. 2, 504-13 (July 15, 1958).

Experiments and theory on the continuous absorption of radiation by atomic-oxygen negative ions are described and discussed. The absorption cross-section for photon energies not too near threshold is obtained directly from one of the experiments. Theory and experiment are combined to give the cross-section in the vicinity of threshold and a precise value of the electron affinity of atomic oxygen. The latter result is EA (O) = 1.465 ± 0.005 eV. The data are used for computation of the radiative attachment coefficient, and other applications of the experimental results are discussed. The potential astrophysical importance of O^- absorption is suggested by the influence of H^- photodetachment on the solar continuous spectrum.

537.56
2433. TRANSPORT PHENOMENA IN COMPLETELY IONIZED GAS CONSIDERING ELECTRON—ELECTRON SCATTERING.
M.S.Sodha and Y.P.Varshni.
Phys. Rev., Vol. 111, No. 5, 1203-5 (Sept. 1, 1958).

Hall mobility and other transport properties of electrons in a completely ionized gas were investigated when a magnetic field is applied, taking into account electron—electron scattering. Results are presented for different mean ionic charges.

537.56
2434. BEAM—PLASMA INTERACTION.
D.W.Mahaffey, G.McCullagh and K.G.Emeleus.
Phys. Rev., Vol. 112, No. 4, 1052 (Nov. 15, 1958).

Measurements were made of plasma electron concentration and oscillation intensity through some inhomogeneous low-pressure hot-cathode discharges traversed by electron beams. A strong tendency has been found for oscillations to grow in amplitude when a beam moves down a plasma concentrating gradient, and to die out when a beam moves up a gradient.

537.56 : 538.566.2
2435. CONDUCTIVITY OF PLASMAS TO MICROWAVES.
E.A.Desloge, S.W.Matthysse and H.Margenau.
Phys. Rev., Vol. 112, No. 5, 1437-40 (Dec. 1, 1958).

If one assumes that the effect of an alternating electric field on an electron in a slightly ionized gas is on the average an addition, in the direction of the field, of a velocity component, the magnitude of which is dependent on the speed of the electron, then it is possible to derive very simply the expression for conductivity obtained earlier by Margenau. In addition an alternative expression is proposed which is of interest because it avoids difficulties with negative conductivities encountered by Margenau's formula.

537.56
2436. PLASMA OSCILLATIONS WITH DIFFUSION IN VELOCITY SPACE. A.Lenard and I.B.Bernstein.
Phys. Rev., Vol. 112, No. 5, 1456-9 (Dec. 1, 1958).

A model of plasma oscillations in the presence of small-angle collisions is presented which admits of exact analytic solution. Certain features of the true collision terms are preserved. Namely, the effect of collisions is represented by a diffusion in velocity space which makes the distribution function tend to the Maxwell distribution and which conserves the number of particles. In the limit of infrequent collisions the results of Landau are recovered.

537.56
2437. TRANSVERSE PLASMA WAVES AND PLASMA VORTICES.
O.Buneman.
Phys. Rev., Vol. 112, No. 5, 1504-12 (Dec. 1, 1958).

Plasmas at high-electron temperatures can carry transverse waves in which self-magnetic fields and relativistic effects become important. In this paper the relativistic perturbation equations for an isotropic uniform plasma are solved as an initial-value problem, i.e. by Laplace transformation, and the propagation or dispersal of both longitudinal and transverse perturbations is calculated. In both cases transients occur which have a continuous frequency spectrum. While transverse perturbations also yield pure persistent waves (with phase velocity exceeding that of light) of all wavelengths, longitudinal perturbations of very short wavelength will not be propagated as pure waves but will die out eventually with only longer wavelengths persisting. The transverse plasma perturbations discussed in the analysis are nonvortical and the dispersal of vortices is covered by a separate discussion. The vortices do not give rise to a new mode of propagation of perturbations.

537.56
2438. ON THE STABILITY OF PLASMA IN STATIC EQUILIBRIUM. M.D.Kruskal and C.R.Oberman.
Phys. of Fluids, Vol. 1, No. 4, 275-80 (July-Aug., 1958).

Criteria useful for the investigation of the stability of a system of charged particles are derived from the Boltzmann equation in the small m/e limit. These criteria are obtained from the examination of the variation of the energy due to a perturbation, when subject to the general constraint that all regular, time-independent constants of the motion (including the energy) have their equilibrium values. The first-order variation of the energy vanishes trivially, and the second-order variation yields a quadratic form in the displacement variable ξ (which may be introduced because of the well-known properties of this limit). The positive-definiteness of this form is a sufficient condition for stability. Several theorems are stated comparing stability under the present theory with that under conventional hydromagnetic fluid theories where heat flow along magnetic lines of force is neglected. Generalizations can be made to systems where the effect of collisions is included.

537.56

2439. EXPERIMENTS ON ION CYCLOTRON RESONANCE.
T.H.Stix and R.W.Palladino.
Phys. of Fluids, Vol. 1, No. 5, 446-51 (Sept.-Oct., 1958).

Theoretical calculations indicate that an attractive possibility for heating the ions of a plasma directly, swiftly, and efficiently is to feed energy into ion cyclotron waves and cause this wave energy to thermalize. Experiments at the milliwatt power level verify the existence of a resonance in a helium plasma at the cyclotron frequency of the doubly charged helium ion. The variation of the plasma loading with magnetic field strength is markedly asymmetrical, in agreement with the theory of ion cyclotron wave generation. The observed plasma loading indicates an efficiency of power transfer between the induction coil and the plasma greater than 60%.

537.56

2440. INTERFEROMETRIC MEASUREMENT OF ELECTRON CONCENTRATIONS IN PLASMAS. R.A.Alpher and D.R.White.
Phys. of Fluids, Vol. 1, No. 5, 452-3 (Sept.-Oct., 1958).

Plasma dispersion at optical frequencies was used to measure electron concentration in a 15 m long shock tube containing thermally ionized argon. The total refractive index was measured with a Mach–Zehnder interferometer using a 0.1 μsec spark light-source. The method is applicable for densities of 10^{16}-10^{18} electrons/cm^3.
D.Walsh

537.56 : 551.510.535

2441. PLASMA MOTIONS INDUCED BY SATELLITES IN THE IONOSPHERE. L.Kraus and K.M.Watson.
Phys. of Fluids, Vol. 1, No. 6, 480-8 (Nov.-Dec., 1958).

The electrohydrodynamic phenomena associated with the high-velocity motion of a charged body in a plasma are investigated with a view to applications to satellite motion in the ionosphere. It is shown that the effect of the electric field due to the charge on the body in inducing collective motion leads to similar results both for high- and low-density gases. By using a linearized theory, formulae are obtained for the electrohydrodynamic drag and for the increased ionization in the Mach cone behind the body.

537.56

2442. COLLECTIVE OSCILLATIONS IN A COLD PLASMA.
P.L.Auer, H.Hurwitz, Jr and R.D.Miller.
Phys. of Fluids, Vol. 1, No. 6, 501-14 (Nov.-Dec., 1958).

The collective motions of a fully ionized cold plasma in a uniform external magnetic field are treated by standard small amplitude theory. Finite temperature and collision effects are neglected. Specializing the analysis to a neutral plasma of uniform unperturbed density containing electrons and ions of one species, one obtains a dielectric tensor and dispersion relation which is a special example of results previously given by Aström. A detailed discussion of the exact dispersion relation is given for the entire frequency spectrum, and completeness theorems are presented with the aid of scalar potentials representing the electromagnetic field quantities. It is found that when the Alfvén dielectric constant $\alpha = 4\pi n(m + M)c^2/B_0^2$ becomes comparable in magnitude to the ion-to-electron mass ratio, the plasma space charge may play an import important role in determining the nature of collective oscillations. In particular, if the axial wavelength of the perturbation is sufficiently large, the singularities of the effective dielectric constant become displaced from the neighbourhood of the particle cyclotron frequencies to hybrid frequencies, which, in the limit of high plasma density, become equal to the geometric mean of the cyclotron frequencies and the plasma frequency, respectively. The last two sections discuss particle orbits in idealized oscillatory modes and simplified boundary value problems associated with plasma resonance.

537.56

2443. VLASOV INSTABILITY IN LONGITUDINAL PLASMA OSCILLATIONS. P.L.Auer.
Phys. Rev. Letters, Vol. 1, No. 11, 411-13 (Dec. 1, 1958).

Deduces a criterion for stability and a necessary condition for instability in a fully ionized plasma. The criterion is considered to have valid application to solar plasmas.
C.G.Morgan

537.56

2444. ON NITROGEN IONS IN A PLASMA. H.Dreeskamp.
Z. Naturforsch., Vol. 12a, No. 11, 876-81 (1957). In German.

A simple double-focusing spectrometer (resolving power 50) was used to investigate the nitrogen ions formed in a low pressure discharge. Only N$^+$ and N$_2^+$ were observed. However, in a drift tube experiment N$_3^+$ ions were also observed. These results are discussed in the light of a theoretical investigation.
A.E.I. Research Laboratory

537.56

2445. THE STABILITY OF A CYLINDRICALLY SYMMETRIC PLASMA CONFIGURATION WITH VOLUME CURRENTS.
K.Hain and R.Lüst.
Z. Naturforsch., Vol. 13a, No. 11, 936-40 (Nov., 1958). In German.

The stability is investigated by the method of small perturbations. The problem is reduced to only one eigenvalue differential equation of second order. For a special current distribution with relatively strong concentration at the axis, the eigenvalues are computed numerically. For this current distribution, particularly at long wavelengths, instability shows up. The rates of growth for different kinds of perturbations are given as a function of the wavelength.

537.56

2446. ON THE ELECTRON TEMPERATURE OF A PLASMA IN AN ALTERNATING ELECTRIC FIELD. A.V.Gurevich.
Zh. eksper. teor. Fiz., Vol. 35, No. 2(8), 392-400 (1958). In Russian.

The heating of electrons in a plasma in an alternating electric field is considered. It is shown that electron gas can exist in two stable states with different temperatures; transition from one state to another occurs at certain critical values of the field amplitude and is accompanied by an appreciable change in the electron temperature. A peculiar type of hysteresis in the dependence of the electron temperature on the field amplitude and frequency is observed. The influence of a constant magnetic field on this effect is also taken into account. An expression was obtained for the complex conductivity of a plasma in an alternating electric and constant magnetic field (allowing for collisions between the electrons).

537.56

2447. LOW-FREQUENCY PLASMA OSCILLATIONS IN A MAGNETIC FIELD. K.N.Stepanov.
Zh. eksper. teor. Fiz., Vol. 35, No. 5(11), 1155-60 (1958). In Russian.

Low-frequency electron–ion longitudinal oscillations in a plasma located in a magnetic field are considered.

537.56 : 532.5 : 538.3

PLASMA CONTAINED IN A TORUS. AXIALLY SYMMETRIC SOLUTION OF THE MAGNETOHYDROSTATIC EQUATION.
See Abstr. 1605

537.56 : 532.5 : 538.3

STABILITY OF A PLASMA. See Abstr. 1607

537.56 : 539.17

THE STELLARATOR CONCEPT. See Abstr. 1792

537.56 : 530.145

QUANTIZATION OF PLASMA THEORY. DISPERSION RELATIONS. See Abstr. 2047-8

537.56 : 536.23

THERMAL CONDUCTIVITY OF AN ELECTRON GAS IN A GASEOUS PLASMA. See Abstr. 2264

537.56 : 523.161

COLLISION OF TWO HIGHLY IONIZED CLOUDS OF GAS. See Abstr. 2002

537.56

2448. FORMATION OF I$^-$ ION FROM I$_2$ BY RESONANCE CAPTURE. D.C.Frost and C.A.McDowell.
J. chem. Phys., Vol. 29, No. 4, 964-5 (Oct., 1958).

Using a technique previously described (Abstr. 9249/1957) ionization efficiency curves were obtained for the formation of I$^-$ (and of SF$_6^-$ for calibration purposes). The I$^-$ curve is asymmetric, having lower and upper energy limits of 0.03 and 1.09 eV and a single maximum at 0.34 eV.
J.Dutton

537.56

2449. INTERACTION OF SLOW ELECTRONS WITH ATOMIC OXYGEN AND ATOMIC NITROGEN. M.M.Klein and M.A.Brueckner.
Phys. Rev., Vol. 111, No. 4, 1115-20 (Aug. 15, 1958).

The polarization potential for an electron in the field of an oxygen atom was determined by utilizing recent experimental results on the binding energy of O$^-$. The corresponding polarization potential for atomic nitrogen has been obtained from the results for oxygen by an extrapolation based on the theory of polarization. From these results the photodetachment cross-section for O$^-$ and the scattering cross-sections for oxygen and nitrogen were calculated. The photodetachment cross-section is in good agreement with experimental results.

The scattering cross-sections are compared with other recent calculations. It is also shown on the basis of the general theory of the photodetachment cross-section that the energy dependence of the cross-section determines the scattering length for electron scattering. The agreement of the computed photodetachment cross-section with experiment is therefore a direct check on the scattering prediction.

537.56 : 539.19

2450. EFFECTIVE CROSS-SECTIONS FOR CAPTURE OF SLOW ELECTRONS BY SOME HALOGENATED MOLECULES AND BY O_2 AND H_2O MOLECULES. N.S.Buchel'nikova.

Zh. eksper. teor. Fiz., Vol. 35, No. 5(11), 1119-30 (1958). In Russian.

The effective cross-sections for capture of slow electrons by the molecules SF_6, CCl_4, CF_3I, CCl_2F_2, BCl_3, HCl, HBr and the cross-sections for capture of electrons of several eV energy by O_2 and H_2O molecules are measured by the single-collision method, assuming quasi-monochromatic electrons. The width of the electron energy distribution was 0.2-0.3 eV, the energy scale being given with an accuracy of about 0.01-0.02 eV. The following peak capture cross-sections were obtained: $SF_6 : 5.7 \times 10^{-16}$ cm², $CCl_4 : 1.3 \times 10^{-16}$ cm², $CF_3I : 17.8 \times 10^{-17}$ cm², $CCl_2F_2 : 5.4 \times 10^{-17}$ cm², $BCl_3 : 2.8 \times 10^{-17}$ cm², HBr : 5.8×10^{-17} cm², HCl : 3.9×10^{-18} $H_2O : 4.8 \times 10^{-18}$ cm², $O_2 : 1.3 \times 10^{-18}$. The potential of appearance of the O^- ion from O_2 was found to equal 4.63 ± 0.04 eV, and for the H^- ion from H_2O 5.45 × 0.09 eV.

537.562

2451. ON THE DIFFUSION THEORY OF THE POSITIVE COLUMN IN ELECTRONEGATIVE GASES. J.Wilhelm.

Naturwissenschaften, Vol. 45, No. 19, 459 (1958). In German.

A simple electronegative gas is considered where in addition to electrons one species of negative and positive ions is admitted as charge carriers. A balance is struck between ionization by collision with electrons, formation of negative ions by combination of an electron with a neutral particle, and loss of neutral particles as a result of dissociation initiated by a collision. The carrier distribution over the cross-section of the column has been calculated, and the solution has been found for a transition from a sink to a source inside the plasma. R.Schnurmann

537.564

2452. THE ATTACHMENT OF SLOW ELECTRONS IN AIR AND OXYGEN. B.A.Tozer, R.Thorburn and J.D.Craggs.

Proc. Phys. Soc., Vol. 72, Pt 6, 1081-6 (Dec., 1958).

Calculations are presented to show that a satisfactory explanation of electron attachment coefficients, under low-current discharge conditions, and for values of X/p greater than 10 V cm^{-1} (mm Hg)$^{-1}$ in both air and oxygen can be obtained if it is assumed that attachment takes place only in the form of resonant dissociative attachment to oxygen, and that a Maxwellian distribution of electron velocities exists in the electron swarm in discharges where the X/p values lie in the range $10 < X/p < 60$. Use of the electron drift and agitation velocity data of Crompton, Huxley and Sutton (1953) and of Townsend and Tizard (1913) shows better agreement with the calculations given here in the case of the latter workers' results.

537.564 : 539.18

2453. THE ELECTRON CAPTURE CROSS SECTIONS FOR PROTONS IN HELIUM. C.A.Haywood.

Proc. Phys. Soc., Vol. 73, Pt 2, 201-14 (Feb., 1959).

The impact parameter formulation of the method of perturbed stationary states is used to calculate the cross-section for electron capture by protons in helium. The $\sigma-\sigma$ transition from ground state to ground state is investigated. A one-body formulation is used in which the captured electron moves initially in the combined field of the other electron, the helium nucleus and the incident proton. The presence of the passive electron is allowed for by using as the initial wave-function before the collision, an approximation to that calculated from the self-consistent field for the helium atom. During the collision this initial wave-function is modified by the introduction of a variational parameter which is determined by a minimization condition for the energy. The possibility of using the one-body formulation for more complex systems is demonstrated by calculations of the electron-capture cross-section for protons in argon and neon.

537.564

2454. OBSERVATIONS ON GAS IONIZING RADIATIONS. A.Przybylski and H.Raether.

Z. Naturforsch., Vol. 13a, No. 3, 234 (March, 1958). In German.

Briefly describes measurements of the absorption coefficients for photo-ionizing radiations in gases using an ionization chamber absorber region. Data for oxygen are given. A value of absorption coefficient μ = 38 cm^{-1} at 760 mm Hg was obtained.

J.D.Craggs

537.564

2455. ON APPLICABILITY OF MASSEY'S ADIABATIC HYPOTHESIS TO DOUBLE CHARGE-EXCHANGE PROCESSES. Ya.M.Fogel', R.V.Mitin, V.F.Kozlov and N.D.Romashko.

Zh. eksper. teor. Fiz., Vol. 35, No. 3(9), 565-73 (1958). In Russian.

The question of applicability of Massey's adiabatic hypothesis to double charge-exchange processes is considered. An analysis of the ion-velocity dependence of the effective cross-sections for double charge-exchange of some types of ions in inert gases shows that the position of the maximum of the respective curves corresponds to Massey's adiabatic criterion. In carrying out the analysis the existence of excited ions in the primary beam, as well as the formation of slow excited doubly charged ions, should be allowed for. As in the case of the ordinary type of charge-exchange the constant (a) in the case of double charge-exchange varies slightly from one ion-molecule pair to another. The mean value of a for double charge-exchange in inert gases is 1.5 A. The value of a for double charge-exchange in molecular gases differs sharply from this value.

537.564

2456. CAPTURE AND LOSS OF ELECTRONS IN COLLISIONS BETWEEN FAST CARBON AND OXYGEN ATOMS WITH GAS MOLECULES. Ya.M.Fogel', V.A.Ankudinov and D.V.Pilipenko.

Zh. eksper. teor. Fiz., Vol. 35, No. 4(10), 368-74 (1958). In Russian.

The effective cross-sections for capture and loss of electrons by carbon and oxygen atoms with energies from 10 to 65 keV experiencing collisions with atoms of He, Ne, A, Kr, Xe and H_2, N_2 and O_2 molecules were measured. The effective cross-section for capture of an electron by fast atoms is found to increase with increase of the affinity energy of the atom. The effective cross-section for electron loss by fast atoms non-monotonically depends on the first ionization potential of the atom. Massey's adiabatic criterion is valid for electron capture processes by fast atoms. The constant a for these processes is 3 A.

537.568

2457. PRESSURE AND TEMPERATURE VARIATION OF THE ELECTRON-ION RECOMBINATION COEFFICIENT IN NITROGEN. E.P.Bialecke and A.A.Dougal.

J. geophys. Res., Vol. 63, No. 3, 539-46 (Sept., 1958).

The electron—ion recombination coefficient α_{ei} in ionized nitrogen gas was investigated in the range from 0.2 to 2 mm Hg, and at electron temperatures from 92° to 300° K, corresponding to various low electron energies. At 1.3 mm Hg, α_{ei} varies from about 8.5×10^{-7} cm³/sec, at 300° K, to 6.7×10^{-6} cm³/sec, at 92° K, almost an order of magnitude difference. Discussion of the possible modes of recombination in a nitrogen gas plasma is given and dissociative recombination is found to be the most probable means of electron loss. Microwave transmission methods were used in this study.

COSMIC RAYS

537.591 : 523.745

2458. CORRELATION OF COSMIC RAY INTENSITY AND SOLAR ACTIVITY. H.V.Neher and S.E.Forbush.

Phys. Rev. Letters, Vol. 1, No. 5, 173-4 (Sept. 1, 1958).

It is pointed out that yearly averages of ionization data at Huancayo correlate very well with the average value of the ionization measured at 90 000 feet at Thule, and that there is very good anti-correlation with the yearly average sunspot number. The large ratio of 19:1 for the percentage change near the N geomagnetic pole to that at the equator, is due primarily to the large numbers of low energy primary particles, which were present during the solar minimum of 1954, and could get through the earth's magnetic field at Thule. P.Rothwell

537.591.1

2459. A STUDY OF μ-MESONS INCIDENT AT LARGE ZENITH ANGLES. B.G.Wilson.

Canad. J. Phys., Vol. 37, No. 1, 19-29 (Jan., 1959).

A Geiger counter telescope was employed to study μ-mesons incident at large zenith angles. The counters were hodoscoped in pairs enabling the direction and angle of incidence of the particles to be determined. The intensity has been analysed as a function of arrival time but no significant variation has been found either in solar time or sidereal time. However, a variation in solar time has been noted on analysis of extensive air showers measured concurrently. The angular variation of intensity has been studied and absolute rates obtained; these rates have been compared with those of an earlier determination showing excellent agreement. Some evidence has been obtained of a directional anisotropy in the μ-meson flux as measured at the apparatus.

537.591.1 : 539.12

2460. THE POLARIZATION OF COSMIC RAY MUONS.

J.M.Fowler, H.Primakoff and R.D.Sard.
Nuovo Cimento, Vol. 9, No. 6, 1027-45 (Sept. 16, 1958).

Cosmic-rays muons of definite energy and direction of motion are expected to show a partial longitudinal polarization because of the falling energy spectrum of the parent pions. The general theory of muon polarization in $\pi \rightarrow \mu$ decay in flight is worked out, and applied to cyclotron as well as cosmic-ray experiments. Cosmic-ray muons are predicted to have a partial longitudinal polarization of about 23%. The theory is also applied to the $K \rightarrow \mu$ decay. An experiment was carried out to test the prediction for cosmic-ray muons. Decay electrons from muons stopped in an aluminum absorber are detected in identical scintillation counters placed symmetrically above and below the absorber. The delay and amplitude of each observed pulse was measured and used to sort out the $\mu^+ \rightarrow e^+$ decays from the $\mu^- \rightarrow e^-$ and background contributions. The ratio of $\mu^+ \rightarrow e^+$ events detected in the upper and lower scintillators is 1.14 ± 0.07, as compared with a theoretical prediction of about 1.11. To test the symmetry of the apparatus the experiment was also carried out with an absorber of salt, which is known to depolarize stopped muons almost completely. The upper to lower ratio is in this case 1.03 ± 0.06, to be compared with the theoretically expected value of about 1.02. It is concluded that the various assumptions made in the theory of muon polarization in $\pi \rightarrow \mu$ decay in flight are correct and that muons suffer negligible depolarization while losing 2 GeV energy in the atmosphere.

537.591.1

2461. MULTIPLE NEUTRON PRODUCTION IN A COSMIC RAY NEUTRON MONITOR PILE.

M.A.Collins.
Nuovo Cimento, Vol. 10, No. 3, 428-34 (Nov. 1, 1958).

A measurement of the number of neutrons produced in the lead of a paraffin—lead cosmic-ray neutron detector of the Chicago design has been made. The experiment indicates that an average of nine neutrons are created per event.

537.591.15

2462. AIR SHOWERS OF SIZE GREATER THAN 10^5 PARTICLES. I. CORE LOCATION AND SHOWER SIZE DETERMINATION.

M.H.Brennan, D.D.Millar and C.S.Wallace.
Nature (London), Vol. 182, 905-11 (Oct. 4, 1958).

An apparatus is described which consists of a 70 m × 30 m array of scintillators associated with a cloud chamber, Cherenkov detector, Geiger counters and neutron monitor. Data is recorded on teleprinter tape which is fed into a digital computer. This determines the core position and size of each shower by varying the parameters of an assumed lateral structure function. An integral shower spectrum in agreement with that of other workers was found, despite the fact that the apparatus is designed for shower structure study rather than for absolute intensity determination. R.H.W.Johnston

537.591.15 : 539.12

2463. AIR SHOWERS OF SIZE GREATER THAN 10^5 PARTICLES. II. ČERENKOV RADIATION ACCOMPANYING THE SHOWERS.

M.H.Brennan, J.Malos, D.D.Millar and C.S.Wallace.
Nature (London), Vol. 182, 973-7 (Oct. 11, 1958).

The Cherenkov detector associated with the apparatus of Pt I (see preceding abstract) is described. It was found that Cherenkov light could be detected at angles up to 30° from the air-shower axis. This indicates that the shower particle angular distribution cannot be ignored. R.H.W.Johnston

537.591.15

2464. AIR SHOWERS OF SIZE GREATER THAN 10^5 PARTICLES. III. COMPARISON BETWEEN THE RESPONSE OF GEIGER COUNTERS AND SCINTILLATION COUNTERS.

M.H.Brennan, D.D.Millar, M.H.Rathgéber and C.S.Wallace.
Nature (London), Vol. 182, 1053-4 (Oct. 18, 1958).

Particle densities at the location of a Geiger counter tray were computed using data from the scintillator array (see two preceding abstracts). R.H.W.Johnston

537.591.15

2465. INVESTIGATION OF EXTENSIVE AIR SHOWERS CONTAINING NUCLEAR ACTIVE PARTICLES.

G.Bózoki, E.Fenyves, T.Sándor and A.Somogyi.
Nuclear Phys., Vol. 7, No. 6, 677-86 (Aug., 1958).

The exponent of the density spectrum of the electronic component of extensive air showers containing nuclear-active particles was determined to be $\gamma = 1.34 \pm 0.08$ assuming that the density of nuclear-active particles is proportional to the density of electrons in air showers. The agreement of the exponent found in the present experiment with that determined earlier for extensive air showers ($\gamma = 1.43 \pm 0.02$) with the same arrangement, which, however, consisted only of the electron detectors, supports the above assumption. From this it follows that the density spectrum of nuclear-active particles has the form of a power law with an exponent approximately equal to γ. Furthermore, the decoherence curve between the electron and nuclear-active particle detectors was measured. The experimental results are briefly discussed.

537.591.15

2466. THE ABSOLUTE DENSITY DISTRIBUTION OF COSMIC-RAY AIR SHOWERS AT LOW DENSITIES.

H.S.Murdoch.
Nuclear Phys., Vol. 8, No. 2, 157-70 (Sept. [2], 1958).

The integral density distribution of cosmic-ray air showers was found to be

$$N(>\rho) = 7.9\rho^{-(1.34 + 0.018 \ln\rho)} \ \mathrm{min}^{-1}$$

at densities $\approx 1\ \mathrm{m}^{-2}$ in agreement with the results of most other workers at somewhat higher densities. It is shown that the hodoscope method is not valid for determination of the distribution over a range of density and that the deduction by Broadbent et al. (Abstr. 8099/1950) of a constant exponent over a wide range of density is erroneous. Good agreement for the absolute rate is obtained from the results of many workers when these are suitably reduced to a common basis as regards range of density, altitude and counter tray separation, the rate quoted being for sea-level and 5 metres separation between trays.

537.591.15

2467. INVESTIGATION OF THE ANGULAR DISTRIBUTION OF SECONDARY PARTICLES IN SHOWERS PRODUCED BY HIGH-ENERGY NUCLEONS.

L.A.San'ko, Zh.S.Takibaev and Ts.I.Shakhova.
Zh. eksper. teor. Fiz., Vol. 35, No. 3(9), 574-83 (1958). In Russian.

The angular distribution of secondary shower particles produced in the stratosphere by nucleons with energies above 50 BeV is investigated. An analysis of the distribution is carried out on the basis of the theory of multiple production of mesons in collisions of nucleons with nucleons or with a column consisting of several nucleons in the target nucleus.

537.591.15

2468. INVESTIGATION OF EXTENSIVE COSMIC-RAY SHOWERS UNDER DENSE SUBSTANCES.

S.I.Nikol'skiĭ and A.A.Pomanskiĭ.
Zh. eksper. teor. Fiz., Vol. 35, No. 3(9), 618-30 (1958). In Russian.

Absorption of extensive atmospheric shower particles in an absorber of low atomic number was investigated at an altitude of 3860 m above sea level. An energy analysis of the data obtained indicates that in the lower third part of the atmosphere about 60% of the energy of the nuclear-active component is transferred to μ-mesons and neutrinos. Some of the data seem to indicate that the absorption of shower particles increases as one goes over to showers with a total number of particles $N > 10^5$.

537.591.15

2469. ON THE ANGULAR DISTRIBUTION OF HIGH-ENERGY BROAD ATMOSPHERIC SHOWERS.

V.V.Guseva, G.T.Zatsepin and G.B.Khristiansen.
Zh. eksper. teor. Fiz., Vol. 35, No. 4(10), 833-7 (1958). In Russian.

A cloud chamber and a large number of counters arranged in a hodoscope were employed to study the angular distribution of extensive atmospheric showers induced by extremely high energy electrons of $\sim > 10^{17}$ eV. The data thus obtained indicate that, contrary to the conventional viewpoint, at mountain heights these showers have passed through their maximum of development.

537.591.2

2470. ACCELERATION OF COSMIC RAYS IN A FLUCTUATING MAGNETIC FIELD.

V.M.Byakov and R.G.Avalov.
Zh. eksper. teor. Fiz., Vol. 35, No. 5(11), 1181-4 (1958). In Russian.

A mechanism of acceleration of cosmic rays is considered in a fluctuating magnetic field of the Galaxy or the atmospheres of some types of stars. During the motion of cosmic particles in these fields the "diffusion" in energy, as well as systematic acceleration, takes place. Computations indicate that the mechanism considered here may be more efficient than the Fermi acceleration mechanism.

537.591.2 : 523.165

INTENSITY PROBLEM IN THE DEFLECTION OF COSMIC RAYS IN THE SOLAR MAGNETIC FIELD. See Abstr. 996

537.591.5

2471. THE FALLING OFF OF THE SOLAR COSMIC RADIATION AFTER THE SUDDEN INCREASE ON 23 FEBRUARY 1956 AND THE GEOMAGNETIC IMPACT CONDITIONS.

A.Ehmert and G.Pfotzer.
Mitt. Max Planck-Inst. Phys. Stratosphäre, No. 6, 14 pp. (1956).
In German.

On the strength of an analysis of neutron registrations of various stations it is concluded that, shortly after the sudden increase, radiation arrives only from a direction very near the sun. The European stations between 35° W. and 10° E. seem to be in a favourable impact zone. The particles have been deflected on their path by about 25°. The mean delay of the beginning of the increase increases strongly from the equator towards the pole. The decrease is in accordance with a uniform hyperbola law for all stations implying that the latitude effect of this phase is constant in time. The indirect radiation should therefore have become isotropic before its entry into the magnetic field of the earth. Also, the uniform decrease favours the explanation that the emission of the c.r. particles did not last longer than the optically visible flare. E.W.Kellermann

537.591.5

2472. THE MOMENTUM DISTRIBUTION OF THE SOLAR COSMIC RADIATION IN THE DECREASING PHASE OF THE SUDDEN RADIATION INCREASE ON 23 FEBRUARY 1956.

G.Pfotzer.
Mitt. Max Planck-Inst. Phys. Stratosphäre, No. 7, 20 pp. (1956).
In German.

On the occasion of the above event the European stations registered at first a direct radiation and later a radiation which had been deflected by interplanetary fields; all other stations registered the indirect radiation only. It is difficult to determine a momentum distribution from the latitude effect of the initial phase. However, in the decreasing phase a uniform time law is observed from which is concluded that in this phase largely isotropic indirect radiation only has been registered. From this a momentum distribution has been derived which can be represented by $f(p)dp = (p/p_0)^{-6 \pm 0.5}$ E.W.Kellermann

537.591.5

2473. THE COSMIC RAY FLARE OF 23 FEBRUARY 1956 AND ITS EFFECT ON THE NEW ZEALAND RADIOCARBON DATING EQUIPMENT.

G.J.Fergusson and G.J.McCallum.
New Zealand J. Sci. Technol. B, Vol. 38, No. 6, 577-87 (May, 1957).

The flare was detected by the New Zealand radiocarbon dating equipment as an increase in the background counting rate. A comparison of the increase of meson and neutron intensity showed that 58.5 ± 2.6% of the normal background rate is caused by the nucleonic component of the cosmic radiation. Consideration has been given to the mechanisms by which the proportional counter detects the nucleonic component. As the sensitivity of the counter to this component cannot be decreased easily, a neutron monitor has been installed to monitor the intensity of the nucleonic component.

537.591.5

2474. UNUSUAL COSMIC-RAY INTENSITY FLUCTUATIONS OBSERVED AT SOUTHERN STATIONS DURING OCTOBER 21st-24th, 1957.

K.G.McCracken and N.R.Parsons.
Phys. Rev., Vol. 112, No. 5, 1798-801 (Dec. 1, 1958).

Observations are reported from four southern stations. These fluctuations exhibit unusual features which suggest the existence of a short-lived and highly directional anisotropy of the primary radiation during the period immediately preceding a Forbush-type decrease.

537.591.5

2475. ON THE INCREASE IN COSMIC RADIATION ON 23 FEBRUARY 1956.

U.Pfeiffer.
Z. Naturforsch., Vol.12a, No. 6, 513-14 (1957). In German.

An overall increase in the strength of cosmic radiation, at Göttingen, on 23 February 1956, was detected and analysed by a suitably shielded arrangement of coincidence counters. Preliminary analysis of the primary particles and correlation with the secondaries indicate that the flux of heavy particles was 32% above normal, and that of light particles, 50%. J.W.Gardner

537.591.5

2476. MEASUREMENT OF THE COSMIC-RAY INTENSITY IN THE STRATOSPHERE AT VARIOUS HEIGHTS AND LATITUDES.

A.N.Charakhchyan and T.N.Charakhchyan.
Zh. eksper. teor. Fiz., Vol. 35, No. 5(11), 1088-102 (1958).
In Russian.

Results of measurements of the altitude dependence of particles of the cosmic-ray soft component possessing different ranges are presented for latitudes of 51° and 31°. The altitude dependence of electrons of a given energy is computed on the basis of the energy spectrum of μ-meson production in the atmosphere. The results of the calculations are in good agreement with the results of measurements performed at the latitude of 31° which indicates that the overwhelming majority of particles of the soft component are electrons generated by π-mesons at the indicated latitude. An analysis of the experimental and calculated values for the latitude of 51° indicates the existence of an excess of electrons possessing ranges smaller than 2-3 g/cm². This phenomenon, which is most pronounced at 51°, is most probably caused by γ-quanta emitted in the atmosphere in reactions involving neutron evaporation. The energy flux carried away by these surplus short-range electrons comprise ~ 10% of the total energy flux of the electron component at this latitude. The magnitude of the cosmic-ray energy fluxes at latitudes of 2°, 31° and 51° was determined. On the basis of these data and also of data on the intensity of cosmic-ray particles at the top of the atmosphere at the latitudes 51° and 31°, an expression was obtained for the primary-particle energy spectrum. The primary cosmic-ray particle flux $(N_p + N_\alpha)$ at the equator (2°) was found to equal 0.48 ± 0.04 particles $\text{min}^{-1}\ \text{cm}^{-2}\ \text{sterad}^{-1}$.

537.591.5 : 523.165

INTERPLANETARY MAGNETIC FIELD AND ITS CONTROL OF COSMIC-RAY VARIATIONS. See Abstr. 2007

537.591.8

2477. INTERPRETATION OF THE FREQUENCY DISTRIBUTION CURVE OF THE NUMBER OF PRONGS OF STARS PRODUCED BY COSMIC RAYS IN NUCLEAR EMULSIONS.

J.Lory, C.Lefort and S.Desprez-Rebaud.
C.R. Acad. Sci.(Paris), Vol. 247, No. 16, 1185-7 (Oct. 20, 1958).
In French.

The results of a study of the stars produced by 2.2 BeV protons are presented. A calculation of the expected frequency distribution for cosmic rays, based on these and other results between 0.4 and 6.25 BeV and the known energy spectrum of primary protons, gives values in good agreement with those observed. E.J.Burge

537.591.8 : 539.17

2478. INELASTIC INTERACTION OF COSMIC-RAY PROTONS OF KINETIC ENERGIES ABOVE 7 BeV WITH CARBON AND HYDROGEN NUCLEI.

K.I.Alekseeva and N.L.Grigorov.
Zh. eksper. teor. Fiz., Vol. 35, No. 3(9), 599-611 (1958). In Russian.

Inelastic interaction between cosmic-ray protons of kinetic energy above 7 BeV (mean energy ~ 20 BeV) and carbon and hydrogen nuclei was investigated at a geomagnetic latitude of 31°N at a stratosphere. The measurements were made with the aid of a telescope, inside which a lead filter and the graphite and paraffin targets were located, and a hodoscope system of counters surrounded the telescope and filters. A value of 315 ± 50 millibarns was obtained for the proton—carbon inelastic interaction cross-section. The proton—proton inelastic interaction cross-section was 32 ± 10 millibarns. The average number of charged penetrating particles in showers from carbon was found to be 4.2 ± 0.5 particles per shower and ~ 3.4 particles per shower produced in hydrogen.

537.591.8 : 539.17

2479. INVESTIGATION OF NUCLEAR DISINTEGRATIONS PRODUCED BY CHARGED COSMIC RAYS.

G.V.Khrimyan.
Zh. eksper. teor. Fiz., Vol. 35, No. 5(11), 1076-82 (1958).
In Russian.

Results of an investigation of nuclear disintegration products generated by the charged component of the cosmic radiation are presented. Some methods of separating nuclear disintegrations from showers produced by electromagnetic interaction of μ-mesons are indicated. A differential momentum spectrum of secondary particles created in stars with $n > 2$ was found. It is shown that for generated π-mesons the ratio $N(\pi^+)/N(\pi^-)$ is equal to 1.18 ± 0.23 in the momentum range from 0.12 to 0.9 BeV/c. The π^--mesons comprise 53 ± 5% of secondary particles possessing momenta ≥ 1 BeV/c. The ratio of the number of charged to neutral star-producing particles with energies ~ 30 BeV is 1.2 ± 0.16.

MAGNETISM

538.08

2480. A NEW METHOD OF MEASURING SUSCEPTIBILITY.
C.Hilsum and A.C.Rose-Innes.

Nature (London), Vol. 182, 1082 (Oct. 18, 1958).

A magnetic circuit analogous to a Wheatstone bridge was constructed, using four air gaps as the main reluctances, a permanent magnet as the source of magnetomotive force and an indium antimonide Hall-effect unit as the flux detector. Since a field of 1500 oersted is obtained in each gap and the Hall-effect unit can detect fields smaller than 10^{-4} oersted, a detectable change in the balance occurs if a sample with a susceptibility greater than 10^{-8}c.g.s. units is introduced into any air gap. The electronics are transistorized and the whole equipment is portable. C.Hilsum

538.082.1

2481. FURTHER DEVELOPMENT OF THE VIBRATING-COIL MAGNETOMETER.
K.Dwight, N.Menyuk and D.Smith.

J. appl. Phys., Vol. 29, No. 3, 491-2 (March, 1958).

The vibrating-coil magnetometer is a versatile and sensitive instrument, with greater freedom of sample environment than can otherwise be obtained. There are several practical factors which tend to degrade the performance of the instrument below theoretical expectations. These difficulties are discussed, and improved techniques for overcoming them are described. The resulting performance is compared both to that of the original instrument and to that theoretically obtainable. The present performance is shown to be within an order of magnitude of the theoretical limitation, which constitutes a marked improvement in the quality of the vibrating-coil magnetometer. The capabilities of the instrument are illustrated by several experiments.

538.083.9 : 621.318.2 : 621.317.42

2482. CONCERNING MAGNETIC FIELD EXPLORATION USING ELECTRON PARAMAGNETIC RESONANCE AT CENTIMETRE AND MILLIMETRE WAVELENGTHS.
A.Karp.

J. Electronics and Control, Vol. 5, No. 5, 402-4 (Nov., 1958).

A simple procedure is given for precisely determining the field pattern of a physical magnet system without using cumbersome probes, resonant cavities, or superheterodyne receivers. Exploring the fields of microwave-valve magnets, having field strengths between several hundred and several tens of thousands of gauss, is a typical application.

538.11 : 537.312.62

2483. PROPAGATION OF A MAGNETIC FIELD INTO A SUPERCONDUCTOR.
J.B.Keller.

Phys. Rev., Vol. 111, No. 6, 1497-9 (Sept. 15, 1958).

The propagation of a magnetic field into a superconducting wire of circular cross-section is analysed theoretically. Upper and lower bounds are obtained on t_0, the time required for the field to reach the axis, and on R(t), the inner radius of the normally conducting region. The lower bound is just the approximate result obtained by Sixtus and Tonks, Pippard, and Lifshits. It has been verified experimentally by Faber for applied fields less than 1.04 times the critical field. It is believed that for large applied fields the actual results should be closer to the upper bounds.

538.113

2484. DE HAAS—VAN ALPHEN EFFECT IN PULSED MAGNETIC FIELDS.
A.M.Kosevich.

Zh. eksper. teor. Fiz., Vol. 35, No. 3(9), 738-41 (1958). In Russian.

Quasiclassical quantization formulae were obtained for the motion of an electron in a metal located in a magnetic field whose gradient is perpendicular to the direction of the field. The de Haas—van Alphen effect in a pulsed magnetic field is analysed from the standpoint of the possibility of applying it for investigation of the Fermi surface of the electron gas in a metal.

538.114

2485. INSTABILITY OF BLOCH'S WALLS DUE TO INTERSTITIAL ATOMS IN A BODY-CENTRED FERROMAGNETIC MATERIAL.
G.Biorci, A.Ferro and G.Montalenti.

R.C. Accad. Naz. Lincei, Vol. 24, No. 5, 542-7 (March, 1958). In Italian.

Néel (Abstr. 7407/1952) has given a theory of the time variation of the permeability after demagnetization, based on a gradual rearrangement of the interstitial atoms. He also suggested a simple equation holding when H is a step function. It is shown here that this simple equation cannot account for the macroscopic behaviour of the material. The experimental facts may be explained by assuming that there exists for every 180° wall a position of instability due to the foreign atoms. L.Pincherle

538.114

2486. SPIN WAVES IN A FERROMAGNETIC METAL.
A.A.Abrikosov and I.E.Dzyaloshinskiĭ.

Zh. eksper. teor. Fiz., Vol. 35, No. 3(9), 771-5 (1958). In Russian.

Spin waves in a ferromagnetic metal are examined on the basis of Landau's theory of the Fermi fluid.

538.114

2487. ON THE INTERACTION BETWEEN EXTERNAL AND INTERNAL ELECTRONS IN FERROMAGNETIC TRANSITION ELEMENTS.
Yu.A.Izyumov.

Zh. eksper. teor. Fiz., Vol. 35, No. 5(11), 1148-54 (1958). In Russian.

The interaction between 4s- and 3d-electrons in transition metals is investigated. It is shown that the dynamical part of the interaction manifests itself in the interaction between elementary excitations of the Fermi and Bose type. At low temperatures, elastic collision processes between these excitations dominate; at high temperatures, transition processes begin to play an important role. The magnetization as a function of the temperature and field strength is calculated.

538.221

2488. DOMAIN WALL MOTION IN METALS.
R.W.DeBlois.

J. appl. Phys., Vol. 29, No. 3, 459-67 (March, 1958).

A brief review on the ferromagnetic domain wall is presented, touching on its energy and thickness, its coercive force, and its motion in metal loops, tapes, and wires, as governed by eddy currents and by relaxation processes. The experimental results are presented of an extension of the Sixtus—Tonks experiment to axial domain wall velocities over 50 km/sec, made possible by use of nearly perfect iron whiskers. Plots of axial velocity v. applied field are nonlinear and in some cases show velocity discontinuities at room temperature in the region 3 to 8.5 km/sec. At 77°K velocity discontinuities beginning at 2 km/sec are observed. Nucleating fields of over 250 Oe are indicated. Data analysis yields a relaxation damping coefficient, $\beta_r \approx 10$ g/sec cm^2 for normal domain wall motion.

538.221

2489. THE DEMAGNETIZING ENERGY AND DOMAIN STRUCTURE OF A UNIAXIAL SINGLE CRYSTAL.
M.Fox and R.S.Tebble.

Proc. Phys. Soc., Vol. 72, Pt 5, 765-70 (Nov., 1958).

The conditions under which a reduction in the demagnetizing energy in a uniaxial crystal can be brought about by rotation of the magnetization vectors (μ^* effect) is examined and an expression for the energy reduction is obtained for materials with high anisotropy ($K > 2\pi I^{02}$). The closure domain structure of cobalt was examined by Bitter pattern technique on the curved surface of a disk, and the results give the conditions under which domains of reverse magnetization are preferred. Suggestions for future development are made.

538.221

2490. DOMAIN PROCESSES AND MAGNETIC AND THERMOMAGNETIC BEHAVIOUR OF A SINGLE CRYSTAL OF SILICON IRON.
P.F.Davis.

Rep. Brit. Elect. Res. Assoc., Rep. N/T79, 5pp. (1957).

Bitter pattern observations have enabled some of the details of the magnetization curve to be explained, and have been linked with thermomagnetic measurements for a silicon-iron crystal along a direction of easy magnetization. A material with few inclusions should not only have a low coercive force but should also be nearer saturation at the knee of the magnetization curve than a material with many inclusions, because if it contains few inclusions it will contain few tree trunk domains of reverse magnetization and a few Néel spikes attached to inclusions and grain boundaries. However, it is necessary for the material to contain a few large nucleating centres in order that the magnetization may be reversed in a low field. The sizes of Néel spikes and tree trunk domains depend on the anisotropy of the material; the smaller the anisotropy the smaller are these domains, therefore the lower the anisotropy the more rapidly the material approaches saturation.

538.221

2491. MODIFIED ROTATIONAL MODEL OF FLUX REVERSAL.
E.M.Gyorgy.

J. appl. Phys., Vol. 29, No. 12, 1709-12 (Dec., 1958).

A nonuniform magnetic configuration for rapid rotational flux reversal in square-loop ferrite cores is analysed. It is shown that the demagnetizing effects due to the boundary of the toroid are, to a good approximation, negligible for toroids with cross-sectional radii as small as 2.5×10^{-2} cm. A basic assumption of an earlier rotational model of flux reversal was that these demagnetizing fields could be neglected. The predictions of this modified model at high drives are similar to those of the earlier model. The possibility of correlating H_0 (the intercept of the extrapolated linear region of the inverse switching time v. drive field plot) with more basic parameters through a model of this type is indicated.

538.221 : 538.653

2492. THE CHANGE OF SPONTANEOUS MAGNETIZATION WITH HYDROSTATIC PRESSURE.
D.Gugan.
Proc. Phys. Soc., Vol. 72, Pt 6, 1013-26 (Dec., 1958).

Measurements were made of the effect of pressure on the spontaneous magnetization of nickel, cobalt, and a series of nickel alloys. The measurements were made using a thin-disk permeameter designed to produce high magnetic fields for only a very small power consumption. The results are in good agreement with the results of other hydrostatic pressure experiments and with the results of experiments on the thermodynamically related "forced" volume magnetostriction. An adequate verification of the important thermodynamic relation $(\partial V/\partial H)_{p,T} = -(\partial M/\partial P)_{H,T}$ was obtained for the nickel–iron alloy system. The results do not agree with the anomalous results reported by Stacey who used Bridgman's thin-disk technique of generating high pressures. Under some conditions nickel shows an anomalously large, linear, decrease of spontaneous magnetization with pressure; possible reasons for this are discussed.

538.221

2493. A BITTER FIGURE EXAMINATION OF SOME POLYCRYSTALLINE NICKEL–COBALT ALLOYS.
L.F.Bates and E.D.Isaac.
Proc. Phys. Soc., Vol. 73, Pt 1, 14-16 (Jan., 1959).

A Bitter figure examination of polycrystalline Ni–Co alloys of compositions 21, 29, 46 and 59% Co, respectively, showed domain wall movements to occur in the last three alloys, the field limits being in reasonable agreement with the results of a study of the heat changes accompanying magnetization processes in the alloys.

538.221 : 538.652

2494. THE SATURATION MAGNETOSTRICTION OF NICKEL CRYSTALS AT LOW TEMPERATURES.
W.D.Corner and F.Hutchinson.
Proc. Phys. Soc., Vol. 72, Pt 6, 1049-52 (Dec., 1958).

The saturation magnetostriction λ of two single crystals of nickel were measured over the temperature range 20°K to 500°K by a capacitance bridge method. The (λ,T) curves allow a reasonable extrapolation to absolute zero to be made, giving $\lambda_{111} = -28 \times 10^{-6}$, $\lambda_{100} = -57 \times 10^{-6}$, values which are of the same order as those calculated by Fletcher (Abstr. 2240/1956), $\lambda_{111} = -44 \times 10^{-6}$, $\lambda_{100} = -187 \times 10^{-6}$. An explanation is given for the discrepancy between the results obtained by Corner and Hunt (Abstr. 3883/1955) and the present values.

538.221

2495. THEORY OF THE ANISOTROPY OF THE FERROMAGNETIC RESONANCE ABSORPTION LINE WIDTH.
G.V.Skrotskiĭ and L.V.Kurbatov.
Zh. eksper. teor. Fiz., Vol. 35, No. 1(7), 216-20 (1958). In Russian.

The dependence of the width of a resonance absorption line on the internal field is derived by using the Landau–Lifshits equations. As examples ferrites of single-axis and cubic symmetry are considered.

538.221 : 538.632

2496. THIN FERROMAGNETIC FILMS. HALL EFFECT IN THIN FILMS OF NICKEL.
G.Goureaux, P.Huet and A.Colombani.
C.R. Acad. Sci. (Paris), Vol. 247, No. 2, 189-93 (July 16, 1958).
In French.

Gives results of measurements of the Hall effect in thin films of nickel of thickness 27-1350 A and in fields of 10-35 000 oersted. The results indicate that in films of thickness 180-1350 A, the axis perpendicular to the film is one of easy magnetization and that the domains are oriented perpendicular to the film. In films of thickness less than 100 A, the axis perpendicular to the film is one of difficult magnetization. The region from 100-180 A is one of transition. In the interval 180-1350 A, the initial slope of the Hall voltage–induction curve is a linear function of the resistivity of the deposit. In fields of about 3000 oersted the Hall effect changes sign with films less than 25 A in thickness. A.E.De Barr

538.22

2497. VARIATION OF THE g-FACTOR OF YTTRIUM GARNET IN WHICH THE Cr^{3+} IONS HAVE BEEN SUBSTITUTED FOR THE Fe^{3+} IONS.
R.Vautier and A.J.Berteaud.
C.R. Acad. Sci. (Paris), Vol. 247, No. 17, 1322-4 (Oct. 27, 1958).
In French.

Values of g measured at a wavelength of 3 cm and extrapolated to zero specimen diameter increase with the amount of chromium added, but in a non-uniform manner. A.E.De Barr

538.221 : 621.318.122

2498. MEASUREMENTS OF THE PERMEABILITY TENSOR FOR "FERROXCUBE" AT 24 000 Mc/s.
G.G.Robbrecht and J.L.Verhaeghe.
Nature (London), Vol. 182, 1080 (Oct. 18, 1958).

Spheres and disks of Ferroxcube IVB were placed in a reflection cavity in magnetic fields of up to 15 000 Oe, and the absorption of circularly polarized microwave radiation was measured. The real and imaginary parts of the effective permeability were deduced and a g-value of 2.11 was calculated. C.Hilsum

538.221

2499. FERRIMAGNETIC RESONANCE IN $NiMnO_3$.
H.S.Jarrett and R.K.Waring.
Phys. Rev., Vol. 111, No. 5, 1223-6 (Sept. 1, 1958).

Ferrimagnetic resonance in single crystals of hexagonal $NiMnO_3$ has shown that the magnetic anisotropy is axial and the easy direction of magnetization lies in the basal plane. The magnetic anisotropy field 2K/M equals 5.2×10^4 gauss, corresponding to an anisotropy energy of 2.6×10^6 ergs/cm^3. Resonance could not be observed at any orientation in single crystals of the isomorphous compound $CoMnO_3$.

538.221

2500. ORIGIN OF WEAK FERROMAGNETISM IN RARE-EARTH ORTHOFERRITES.
R.M.Bozorth.
Phys. Rev. Letters, Vol. 1, No. 10, 362-3 (Nov. 15, 1958).

The compounds have the formula $MFeO_3$ with M = Sm(62) to Lu(71) inclusive. An argument is given to show that the ferromagnetism is due to the disturbing action of the crystal field on the much stronger exchange field. The direction of the spontaneous moment depends on the type of ordering and also on the direction of the Fe^{3+} ions. D.J.Olive

538.221

2501. DOMAIN CONFIGURATIONS ON FERRITES.
D.J.Craik and P.M.Griffiths.
Proc. Phys. Soc., Vol. 73, Pt 1, 1-13 (Jan., 1959).

The domain structures of Mn, MnZn, Ni, Cu and Ba ferrite crystals were examined by the conventional and modified Bitter figure techniques. In the cases of Mn, Ni and Ba ferrites the patterns observed are in accordance with the nature of their magnetic constants. The MnZn ferrite crystal examined gave anomalous patterns considered to be due to a strain induced uniaxial anisotropy.

538.221

2502. MULTISPIN AXIS STRUCTURES FOR ANTIFERROMAGNETS.
W.L.Roth.
Phys. Rev., Vol. 111, No. 3, 772-81 (Aug. 1, 1958).

Neutron diffraction intensities were computed for antiferromagnetic spin arrangements in the rocksalt-type structure. If the spin directions in the unit cell occur at relative angles other than 0° or 180°, the neutron scattering from powder specimens does not lead to a unique solution of the spin arrangement. A unique solution can be obtained from neutron scattering by a single-domain crystal. Neutron diffraction from crystals of nickel oxide shows that in all crystals examined, either the magnetic moments were parallel to more than one direction in the crystal, or antiferromagnetic domain were present. The results can be quantitatively accounted for by assuming the crystal consisted of domains with a common magnetic axis.

538.221

2503. ANTIFERROMAGNETISM OF $CuF_2 \cdot 2H_2O$.
G.S.Verma and K.Tokunaga.
Phys. Rev., Vol. 112, No. 5, 1521-2 (Dec. 1, 1958).

The perpendicular and parallel magnetic susceptibilities were calculated on the basis of Nakamura's theory (1953). The computed values of molar susceptibility for the same compound have been compared with the recent measurements of Bozorth and Nielsen and are found to be in good agreement.

538.221

2504. EVIDENCE FOR ANTIFERROMAGNETISM IN $Cu_3(CO_3)_2(OH)_2$ [MINERAL AZURITE].

R.D.Spence and R.D.Ewing.
Phys. Rev., Vol. 112, No. 5, 1544-5 (Dec. 1, 1958).

Proton Resonance was used to study the magnetic behaviour of this mineral. Below 30°K the temperature dependence of the splitting of the proton resonance lines by the copper ions shows strong exchange effects. At 1.86°K a transition takes place and the resonance pattern below the transition indicates an antiferromagnetic state.

538.221 : 536.413.3

INVESTIGATION OF THE ANTIFERROMAGNETIC COMPOUND MnTe. See Abstr. 2265

538.222

2505. ANOMALY IN MAGNETIC ANISOTROPY OF $K_3Fe(CN)_6$ SINGLE CRYSTALS AT LOW TEMPERATURES.

G.Shoffa, O.Ristau and K.Rukpaul.
Zh. eksper. teor. Fiz., Vol. 35, No. 3(9), 641-4 (1958). In Russian.

An anomalous behaviour of the magnetic anisotropy of $K_3Fe(CN)_6$ single crystals near 126°K is described, which is due to the interaction between paramagnetic ions.

538.222

2506. TEMPERATURE DEPENDENCE OF THE PARAMAGNETIC SUSCEPTIBILITY OF NICKEL-ZINC FERRITES.

V.I.Chechernikov and Yu.D.Volkov.
Zh. eksper. teor. Fiz., Vol. 35, No. 4(10), 875-9 (1958). In Russian.

An investigation of the temperature dependence of the paramagnetic susceptibility of nickel-zinc ferrites was carried out. The results of the measurements are in good agreement with theory.

538.222 : 539.2

2507. EFFECT OF UNIFORM COMPRESSION ON THE OSCILLATION OF THE MAGNETIC SUSCEPTIBILITY OF BISMUTH AT LOW TEMPERATURES.

N.B.Brandt and V.A.Ventssel'.
Zh. eksper. teor. Fiz., Vol. 35, No. 5(11), 1083-7 (1958). In Russian.

The influence of uniform pressure of about 1000 atm on the oscillation of the magnetic susceptibility of bismuth in a magnetic field up to 13 kOe (de Haas—van Alphen effect) was investigated at 4.2°-1.6°K. The character of variation of the effective mass tensor, Fermi boundary energy E_0, Dingle factor and electron concentration were estimated with the Landau formula. Assumptions regarding the nature of the electron energy spectrum in bismuth are made.

538.222 : 536.633

MAGNETIC PROPERTIES OF COPPER (II) ACETONYLACETONE. See Abstr. 2287

538.224

2508. MAGNETIC PROPERTIES OF METALS AT LOW TEMPERATURES. IV. EFFECT OF HOMOGENEOUS COMPRESSION ON THE DE HAAS—VAN ALPHEN EFFECT IN ZINC CRYSTALS.

I.M.Dmitrenko, B.I.Verkin and B.G.Lazarev.
Zh. eksper. teor. Fiz., Vol. 35, No. 2(8), 328-39 (1958). In Russian.

A method and apparatus were developed for investigation of the influence of homogeneous compression on the anisotropy of the magnetic properties of crystals at low temperatures. The angular dependence of the oscillation periods of the magnetic susceptibility of free zinc crystals due to the two smallest groups of mobile charges was established. The effect of homogeneous compression at a pressure of $p = 1700$ kg/cm^2 on the period and amplitude of the oscillations due to the smallest groups of mobile charges. A large (40-48%) increase of the periods of these oscillations was found for all values of the angle θ between the field vector and the direction of the chief crystal axis. Homogeneous compression of the crystal is found to cause a strong decrease of the oscillation amplitude and a change on the temperature dependence of the oscillation amplitude. The experimental data are compared with the semi-phenomenological theory of the influence of deformations on oscillation effects in metals at low temperatures.

538.245

2509. PREPARATION AND PROPERTIES OF CRYSTAL-ORIENTED FERROXPLANA SAMPLES.

A.L.Stuijts and H.P.J.Wijn.
J. appl. Phys., Vol. 29, No. 3, 468-9 (March, 1958).

Samples of the hexagonal ferroxplana materials (a generic name of new groups of soft magnetic oxidic materials with hexagonal crystal structure), with a preferential plane for the magnetization, show an increased resonant frequency compared to samples of cubic ferrites with the same permeability. It appeared possible to use the large stiffness for rotation of the magnetization out of the preferential plane, in order to orientate the single crystal particles of a ferroxplana powder in a magnetic field. In this way samples with two different textures were obtained. In one case the basal planes of the crystals have one direction more or less in common (fan texture); in the other case all basal planes lie more or less parallel to each other (foliate texture). In both cases the permeability is appreciably increased, while the resonant frequency is only slightly decreased. Permeabilities of 56 at 90 Mc/s and 28 at 230 Mc/s, both for $\tan\delta = 0.1$, were found. This large increase in permeability is caused mainly by an elimination of the effect of the anisotropic permeability of the crystals.

538.245

2510. SURFACE ENERGY OF A 90° DOMAIN WALL IN IRON.

C.D.Graham, Jr.
J. appl. Phys., Vol. 29, No. 10, 1451-3 (Oct., 1958).

The relative surface energy of a 90° domain wall in a cubic material with $K_1 > 0$ (iron) is evaluated over the range of possible wall orientations. As the plane of the wall passes through a $\{110\}$ plane, the minimum-energy configuration changes from a right-hand to a left-hand rotation of the atomic moments; this leads to a sharp upward cusp in the energy v. orientation curve. The calculated orientation dependence of the surface energy can be used to predict a stable wall position in an iron whisker. The prediction is in reasonable agreement with observation.

538.245

2511. DOMAIN WALL MOTION AND FERRIMAGNETIC RESONANCE IN A MANGANESE FERRITE.

J.F.Dillon, Jr and H.E.Earl, Jr.
J. appl. Phys., Vol. 30, No. 2, 202-13 (Feb., 1959).

From a single crystal of manganese ferrite, specimen cores have been cut which are capable of supporting single domain walls. These cores have been proportioned in two ways, one favouring a movable (110) wall, the other favouring a wall system perpendicular to the (110) plane. The basic experiment consists in applying rectangular current pulses to a winding, and observing the rate of change of flux as presented by the voltage in another winding. At low driving fields, the wall, once torn free of the surface, moves through the crystal at a velocity proportional to the applied field less an internal coercive force. At high fields the pulse shapes indicate complex domain structure. Ferrimagnetic resonance experiments have also been performed on samples cut from the same crystal, and the results of these are given. It is particularly interesting to compare the loss parameter for the equation of motion which is derived from the resonance experiments with that obtained from the wall motion experiment.

538.245

2512. THE INFLUENCE OF INCLUDED CARBON ON THE MOBILITY OF BLOCH WALLS.

B.Rothenstein and J.Hrianca.
Naturwissenschaften, Vol. 45, No. 15, 360 (1958). In German.

The mobility of Bloch walls in iron has been studied by measurement of the effect of a magnetic field on the internal friction, and the effect of included carbon has been examined.

A.E.De Barr

538.245

2513. HYSTERESIS LOOPS OF PICTURE-FRAME SINGLE CRYSTALS OF Al-Fe ALLOYS.

H.Gengnagel.
Naturwissenschaften, Vol. 45, No. 15, 361 (1958). In German.

A picture-frame crystal of 4% Al-Fe with [100] sides was found to have a large coercive force and a low permeability, whilst a similar crystal of 3% Al-Fe had a low coercive force and a sharply rectangular hysteresis loop. Examination of the surfaces of the crystals by Bitter patterns showed the 4% crystal to contain a non-magnetic precipitate that hindered domain wall movement. This was shown to be aluminium oxide.

A.E.De Barr

538.245

2514. THE INFLUENCE OF TEMPERATURE ON THE DISTRIBUTION OF FERROMAGNETIC DOMAINS FROM THE STANDPOINT OF THE COERCIVE FORCE.

B.Rothenstein and J.Hrianca.
Naturwissenschaften, Vol. 45, No. 21, 507-8 (1958). In German.

Measurements of the internal friction of nickel as a function of applied field have been made at temperatures between 16°C and 200°C. The domain distributions indicated by the results are compared with a Maxwell distribution.

A.E.De Barr

538.245

2515. ON THE TEMPERATURE STABILITY OF THE DOMAIN STRUCTURE IN SILICON IRON CRYSTALS.
L.V.Kirenskiĭ and I.F.Degtyarev.
Zh. eksper. teor. Fiz., Vol. 35, No. 3(9), 584-6 (1958). In Russian.

The meridian magneto-optical Kerr effect was employed to investigate the domain structure of 3% silicon iron in the temperature range from 20 to 700°C. It is shown that in the indicated range the domain structure is highly stable.

538.245 : 534.23

ULTRASONIC ABSORPTION BY AND MAGNETIC PROPERTIES OF NICKEL MONOCRYSTALS. See Abstr. 2168

538.27 : 537.312.9

2516. CHANGES OF THE SATURATION MAGNETIZATION AND THE ELECTRICAL RESISTANCE OF IRON—NICKEL ALLOYS ON OMNIDIRECTIONAL COMPRESSION AT LOW TEMPERATURES.
E.I.Kondorskiĭ and V.L.Sedov.
Zh. eksper. teor. Fiz., Vol. 35, No. 4(10), 845-53 (1958). In Russian.

Study was made of the changes in the saturation magnetization and the electrical resistance of the binary iron—nickel alloys, containing 38 and 45% of nickel, under the influence of pressure created by freezing of water in a bomb. The measurements were carried out in the temperature interval from 1.7 to 77°K and in fields up to 7000 Oe. The limiting values of the saturation magnetization and electrical resistance for $T \to 0$ were found to change under omnidirectional compression, the signs of the changes of these two quantities being opposite. The indicated limiting values also change with the growth or decrease of the field at high magnetic field strengths, and for $T \to 0$ the differential magnetic susceptibility in the region of magnetic saturation does not vanish. The relationships between the variation of the limiting values of the saturation magnetization and the electrical resistance induced by pressure or by the field are found to be similar.

538.27 : 534.2

COUPLED MAGNETOELASTIC WAVES IN FERROMAGNETICS AND FERROACOUSTIC RESONANCE. See Abstr. 2156

ELECTROMAGNETISM
MAGNETOHYDRODYNAMICS

538.3 : 621.317.763 : 621.372.8

2517. ELECTROMAGNETIC FIELDS IN CURVED HOLLOW CONDUCTORS. E.Heyn.
Abhandl. Dtsch. Akad. Wiss. Berlin, Kl. Math. Phys. Tech., 1958, No. 4, 41 pp.

Using a perturbation method, the effects of the curvature on the reflection coefficients and on the position of the resonances in high-frequency wavemeters are calculated. W.A.Hepner

538.3 : 532.5

2518. ON THE FUNDAMENTAL EQUATIONS OF MAGNETO-HYDRODYNAMICS AND SOME OF THEIR APPLICATIONS.
J.Carstoiu.
C.R. Acad. Sci. (Paris), Vol. 247, No. 20, 1716-18 (Nov. 17, 1958). In French.

The equations for a uniform liquid of finite conductivity and uniform charge density are expressed in terms of Lagrange variables defining the motion of individual particles of the liquid. It is shown that a charged liquid particle with initial vorticity would create a magnetic field whose intensity increased with time. Speculations are made concerning the relevance of this result to the problem of terrestrial magnetism. R.A.Newing

538.3 : 532.5

2519. MAGNETO-HYDRODYNAMIC OSCILLATIONS OF A PERFECTLY CONDUCTING FLUID SPHERE PLACED IN A UNIFORM MAGNETIC FIELD. T.Rikitake.
J. Phys. Soc. Japan, Vol. 13, No. 10, 1224-30 (Oct., 1958).

An attempt is made to improve theories of magnetohydrodynamic oscillations of a conducting fluid sphere in a uniform magnetic field. Unlike the theories developed by Schwarzschild and Rikitake, analytical expressions for zonal oscillations are obtained rigorously. The eigen-periods are determined approximately. Two fundamental normal modes of oscillation are also approximately obtained and illustrated.

538.3 : 532.5

2520. ON THE FORMATION OF MAGNETO-HYDRODYNAMIC SHOCK WAVES. S.Segre.
Nuovo Cimento, Vol. 9, No. 6, 1054-7 (Sept. 16, 1958).

A solution of the time-dependent nonlinear equations of magnetohydrodynamics for the propagation of plane (finite) waves is discussed, for a simple case in which there is a strong analogy with hydrodynamics.

538.3 : 523.03

2521. THE HELICOIDAL STRUCTURES IN THE COSMICAL ELECTRODYNAMICS. Syun-ichi Akasofu.
Tellus, Vol. 10, No. 4, 409-14 (Nov., 1958).

The general-type solutions of the equation $[\mathrm{curl}(\mathrm{curl}\,H \times H)] = 0$ are studied in the cylindrical systems, according to Lundquist's and Chandrasekhar's methods. In general, the magnetic fields are of helicoidal type in the cylindrical systems. Several examples are studied in the cosmical fields.

538.3 : 532.5 : 537.56

2522. THE STRUCTURE OF HYDROMAGNETIC SHOCK WAVES. I. NON LINEAR HYDROMAGNETIC WAVES IN A COLD PLASMA.
L.Davis, R.Lüst and A.Schlüter.
Z. Naturforsch., Vol. 13a, No. 11, 916-36 (Nov., 1958).

The waves in a cold (no thermal motions) quasi-neutral gas consisting of ions and electrons are treated neglecting collisions, but not neglecting the inertial effects associated with the electric current. Provided the particle trajectories do not make loops, the nonlinear equations for infinite plane compressional waves travelling perpendicular to a uniform magnetic field with unchanging form and speed are reduced to a single second-order ordinary differential equation in the field strength (or the particle displacement normal to the direction of propagation) and solved exactly. The solutions can be expressed in terms of elliptic functions. Curves derived by numerical integration give the important properties of the waves. Power series solutions in the amplitude α, are given, the error being of the order of α^4. Both wave trains and solitary waves are found, all solutions being symmetrical about maxima and minima in the field strength. The wavelengths are of the order of the gyro-radius. The velocities range from zero to twice the Alfvén velocity, higher velocities leading to looped trajectories. By reduction to dimensionless form, all waves are included in a two parameter family. The relation of these waves to hydromagnetic shock waves in low density plasmas is considered and it is concluded that the entire shock will have a thickness determined by the product of the mean time between collisions and the gas velocity with respect to the shock front. This region will be occupied by wave trains whose structure is of the order of the gyro-radius. Two analogues of the Rankine—Hugeniot conditions are given, one in which the regions on the two sides of the "shock-front" are occupied by cold plasmas containing different wave trains, the other being the familiar hydromagnetic shock conditions except that only particle motions normal to the magnetic field are considered. In each all conservation laws are satisfied across the "shock-front" but there seems to be no satisfactory mechanism for the processes within the front.

538.3 : 532.5

2523. INTERACTION BETWEEN A CHARGED CURRENT-CARRYING JET MOVING IN A CIRCLE AND A MAGNETO-DIELECTRIC. A.N.Didenko.
Zh. eksper. teor. Fiz., Vol. 35, No. 3(9), 655-61 (1958). In Russian.

The radiation spectrum of a current-carrying charged jet moving in a circle in homogeneous space is studied. The radiation spectra and lateral forces exerted by the magnetodielectric are investigated for some particular cases of inhomogeneous spaces using Bessel functions and Neuman functions which yield a good approximation even at comparatively small values of the indices and arguments.

538.3 : 532.5

2524. ON THE STABILITY OF SHOCK WAVES IN MAGNETO-HYDRODYNAMICS. A.I.Akhiezer, G.Ya.Lyubarskiĭ and R.V.Polovin.
Zh. eksper. teor. Fiz., Vol. 35, No. 3(9), 731-7 (1958). In Russian.

The regions of instability of a stationary magnetohydrodynamic shock wave with respect to one-dimensional perturbations are determined. It is shown that two types of stable shock wave exist. The types of shock wave which can follow each other are ascertained.

538.3 : 532.5 : 534.222.2

2525. ON THE INTERACTION BETWEEN SMALL PERTURBATIONS AND THE DISCONTINUITIES IN MAGNETOHYDRODYNAMICS AND THE STABILITY OF SHOCK WAVES.
V.M.Kontorovich.
Zh. eksper. teor. Fiz., Vol. 35, No. 5(11), 1216-25 (1958).
In Russian.

A simple geometrical method is presented for construction of waves diverging (reflected and refracted) from a discontinuity surface, produced by the incidence of a plane monochromatic wave on a plane stationary discontinuity surface in a medium describable by equations of magnetohydrodynamics. The case of a shock wave is considered. The stability of shock waves with respect to obliquely incident perturbations is investigated on basis of the results obtained. Variation of the frequency as a result of interaction of small perturbations with shock waves is considered.

538.3 : 532.5 : 537.525

HYDROMAGNETIC INSTABILITY IN A STELLARATOR.
See Abstr. 2373

ELECTROMAGNETIC WAVES AND OSCILLATIONS

538.561 : 621.375.9

2526. THE FERROMAGNETIC MICROWAVE AMPLIFIER.
H.Suhl.
Phys. Today, Vol. 11, No. 9, 28-31 (Sept., 1958).

Recently several types of atomic processes have been used to make amplifiers with lower noise figures than the conventional tube types. This particular one consists of a ferromagnetic medium in a steady magnetic field. It is "pumped" by energy of frequency f_p. The ferromagnetic material lies in a cavity that has resonant frequencies f_1 and f_2 such that $f_1 + f_2 = f_p$. Provided that f_1 mode is orthogonal to the other modes, amplification or oscillation at f_1 can be produced by energy transfer from the pump. Noise measurements have not yet been made but they are expected to correspond to the ambient temperature. D.Walsh

538.561 : 621.318.12 : 621.373.421.14

2527. MICROWAVE AND LOW-FREQUENCY OSCILLATION DUE TO RESONANCE INSTABILITIES IN FERRITES. M.T.Weiss.
Phys. Rev. Letters, Vol. 1, No. 7, 239-41 (Oct. 1, 1958).

Sideband oscillations occur in single crystal yttrium iron garnet disks in a resonant cavity when subject to a d.c. magnetic field and an incident power exceeding 50 mW at 9500 Mc/s. The higher frequency sidebands are larger than those of lower frequency, showing that the incident wave is both frequency and amplitude modulated. With the disk in a straight waveguide, the response curve shows hysteresis (Abstr. 2226/1956). J.H.Mason

538.561 : 621.375.9

2528. ANALYSIS OF THE EMISSIVE PHASE OF A PULSED MASER. H.H.Theissing, F.A.Dieter and P.J.Caplan.
J. appl. Phys, Vol. 29, No. 12, 1673-8 (Dec., 1958).

The operation of a pulsed solid-state maser consists essentially of alternate periods of spin inversion and stimulated spin emission. Inversion can be accomplished by a short driving pulse or an adiabatic rapid passage. In the emission phase a weak signal field causes the spin system to spiral back coherently and radiate. The emissive phase can be treated by equations which for finite relaxation times can not be solved in closed form, but which are amenable to machine computation. Such numerical solutions giving the transverse moment, output field, output power, and power gain as a function of time were computed for various relaxation times, input fields and values of the oscillation parameter. The results are interpreted with respect to applications of both regenerative and superregenerative modes of operation.

538.561 : 621.375.9

2529. THREE-LEVEL SOLID STATE MASER. S.M.Bergmann.
J. appl. Phys., Vol. 30, No. 1, 35-6 (Jan., 1959).

The maximum values of the real and imaginary components of the paramagnetic susceptibility of a three-level solid-state maser are calculated. For the case of $K_3Co(CN)_6$ paramagnetic salt with 0.5% Cr, the values $\chi_{max}' = 2.5 \times 10^{-4}$ and $\chi_{max}'' = 5 \times 10^{-4}$ are obtained. General expressions for the gain and bandwidth of a travelling-wave maser are given. An analogy is brought up between the quality factor Q per unit length of waveguide in the travelling-wave maser and the Q in the cavity maser.

538.561 : 621.375.9

2530. SMALL SIGNAL ANALYSIS OF MOLECULAR BEAM MASERS. J.C.Helmer.
J. appl. Phys., Vol. 30, No. 1, 118-20 (Jan., 1959).

A perturbation calculation gives the resonance polarization of a molecule in an electric field as a function of time. An analysis is then made of maser operation with a divergent, univelocity beam. Equations are derived which give the relative beam intensity required to start oscillation and the molecular Q as a function of cavity length. An optimum cavity length is predicted. This theory is compared with a similar theory of Shimoda (Abstr. 4172/1958) which assumes a Maxwell velocity distribution, and reasonable agreement is obtained. On the basis of this agreement it is possible to define an equivalent divergence of the velocity distributed beam.

538.561 : 621.375.9

2531. BEHAVIOR OF A TWO-LEVEL SOLID-STATE MASER.
I.R.Senitzky.
Phys. Rev. Letters, Vol. 1, No. 5, 167-8 (Sept. 1, 1958).

The purpose of the paper is to explain the amplitude modulation observed in masers by Feher et al. (Abstr. 2653/1958) and by Chester et al. (Abstr. 5139/1958). It is shown that the behaviour is governed by a system of coupled equations, one for the spin and one for the field so that the energy transfers back and forth between the two degrees of freedom. A satisfactory agreement with the observed modulation frequency is obtained. H.Motz

538.561 : 621.375.9

2532. THE MOLECULAR AMPLIFIER. H.C.Wolf.
Z. angew. Phys., Vol. 10, No. 10, 480-8 (Oct., 1958). In German.

A review article attempting to explain solid state and ammonia maser operation. Discussions of noise and parametric amplification are not adequate. H.Motz

538.561 : 621.375.9

2533. PARAMETRIC AMPLIFICATION OF SPACE CHARGE WAVES. A.Ashkin.
J. appl. Phys., Vol. 29, No. 12, 1646-51 (Dec., 1958).

By modulating a beam strongly with a high-level signal, called the "pump" signal, a low-level space charge wave of another frequency imposed on the beam can be parametrically amplified. With the pump frequency twice the signal frequency, 13 dB gain per plasma wavelength has been observed in a movable cavity experiment. Over a 10 in. length of beam the signal has been observed to increase to 41 dB. When the imposed signal wave's frequency is not exactly half the pump frequency, the beam generates another wave called the "idler" such that $\omega_{signal}+\omega_{idler} = \omega_{pump}$ with both signal and idler growing exponentially with distance along the beam. In another experiment with the pump frequency lower than the signal frequency, the signal was observed to increase by 30 dB over a 9.2 in. length of beam.

538.561 : 621.375.9

2534. LOW NOISE IN SOLID STATE PARAMETRIC AMPLIFIERS AT MICROWAVE FREQUENCIES. W.E.Danielson.
J. appl. Phys., Vol. 30, No. 1, 8-15 (Jan., 1959).

The principles of parametric amplification are described through the use of simple low-frequency electrical circuits and their mechanical analogues. Extension of these principles to low-noise amplification at microwave frequencies is made in a qualitative way which emphasizes the physical processes involved. Amplification is only achieved when energy is transferred from a microwave oscillator or pump to the signal frequency, and it is shown why such a transfer may take place in circuits exhibiting variable capacitance or inductance but not in circuits where only a resistance is varied. Major noise sources are discussed and the special role of the image or idler frequency is noted. Experimental data on four different types of parametric amplifier (3 using semiconductor diodes and 1 using ferrite) are given.

538.561 : 621.375.9

2535. GAIN, BANDWIDTH AND NOISE IN A CAVITY-TYPE PARAMETRIC AMPLIFIER USING AN ELECTRON BEAM.
G.Wade and H.Heffner.
J. Electronics and Control, Vol. 5, No. 6, 497-509 (Dec., 1958).

A modulated electron beam flowing across the gap of a resonant cavity can change the gap capacitance at the modulating frequency, thus producing the variable capacitance needed for a parametric amplifier. Such a beam-type parametric amplifier has been proposed independently by the authors and by Bridges and has been constructed by Bridges (see Abstr. 3267/1958). This paper presents an investigation of the gain, bandwidth, and noise figure which can be expected. It shows that complete cancellation simultaneously of the two uncorrelated noise sources in the electron beam, while feasible in principle, is virtually impossible in practice. The conflicting requirements of large beam current for acceptable capacitance variation and large plasma wavelength for optimum noise cancellation lead to practical minimum noise figures in the vicinity of 3 dB. A design example is worked out for an amplifier with pump frequency at 2000 Mc/s amplifying at 500 Mc/s with a gain of about 15 dB. The resulting bandwidth is 43 kc/s. A noise figure of 3.4 dB could be achieved with some difficulty.

538.561 : 621.375.9

2536. A PARAMAGNETIC AMPLIFIER AND GENERATOR USING CHROMIUM CORUNDUM.
G.M.Zverev, L.S.Kornienko, A.A.Manenkov and A.M.Prokhorov.
Zh. eksper. teor. Fiz., Vol. 34, No. 6, 1660-1 (1958). In Russian.

The possible use of a molecular system, in this case a paramagnetic crystal, having three energy levels, as an oscillator or amplifier has been discussed in detail for gadolinium ethyl sulphate (Abstr. 4876/1957). The use of a single crystal of $Al_2O_3.Cr_2O_3$ is proposed here and preliminary experiments are reported. The Cr^{+++} ion lies in an axial electric field which splits the spin quadruplet of the lower singlet orbital level into two doublets the distance between which is $2D = -0.3824\ cm^{-1}$. Oscillation or amplification takes place at about 3000 Mc/s and self-oscillation was obtained at about 2°K. A.L.Mackay

538.565 : 530.145

QUANTUM-MECHANICAL TREATMENT OF E.M. OSCILLATIONS. See Abstr. 2097

538.566 : 621.396.677.85

2537. EXPERIMENTAL INVESTIGATION OF A HOMOGENEOUS DIELECTRIC SPHERE AS A MICROWAVE LENS. R.N.Assaly.
Canad. J. Phys., Vol. 36, No. 10, 1430-5 (Oct., 1958).

The lens investigated was of heptane (liquid) enclosed in a 20.8 cm radius styrofoam shell. Measurements were made by a field probe method at frequencies of 9.6 and 24.0 Gc/s and the H-plane intensity distributions for both cases are plotted in detail. These figures show also the paraxial and marginal foci together with the caustics and theoretical marginal rays. Despite the presence of a large amount of spherical aberration the intensity distributions compare favourably with those of an ideal lens. G.D.Sims

538.566 : 621.371

2538. TRANSMISSION AND REFLECTION OF ELECTROMAGNETIC WAVES IN THE PRESENCE OF STRATIFIED MEDIA.
J.R.Wait.
J. Res. Nat. Bur. Stand., Vol. 61, No. 3, 205-32 (Sept., 1958).

A general analysis is presented for the electromagnetic response of a plane stratified medium consisting of any number of parallel homogeneous layers. The solution is first developed for plane-wave incidence and then generalized to both cylindrical and spherical-wave incidence. Numerical results for interesting special cases are presented and discussed. The application of the results to surface-wave propagation over a stratified ground is considered in some detail.

538.566 : 621.372

2539. ELECTROMAGNETIC SCATTERING BY THIN CONDUCTING PLATES AT GLANCING INCIDENCE.
J.S.Hey and T.B.A.Senior.
Proc. Phys. Soc., Vol. 72, Pt 6, 981-95 (Dec. 1, 1958).

The signal scattered back from rectangular and triangular plates illuminated edge-on in an electromagnetic field is found to be large when the incident magnetic vector is normal to the plates. Explanations are sought in terms of edge diffraction, and experimental measurements indicate that the currents in the plates are predominant near to edges. The extension of rigorous theoretical results on infinite edges to the derivation of currents in finite edges is discussed; and it is shown what type of modification appears necessary to account for the experimental observations. A method of testing a hypothetical current distribution for the boundary conditions is propounded.

538.566

2540. THE KIRCHHOFF–YOUNG THEORY OF THE DIFFRACTIO OF ELECTROMAGNETIC WAVES. O.Laporte and J.Meixner.
Z. Phys., Vol. 153, No. 2, 129-48 (1958). In German.

It is shown that, similar to the case of the diffraction of scalar waves, the double integrals occurring in the Kirchhoff approximation can be converted into line integrals along the boundary of the aperture, and these can be evaluated with the help of the saddle point method. W.A.Hepner

538.566.2 : 537.56

2541. MICROWAVE PROPAGATION IN HOT MAGNETO-PLASMAS. J.E.Drummond.
Phys. Rev., Vol. 112, No. 5, 1460-4 (Dec. 1, 1958).

The indices of refraction of circularly polarized microwave signals propagating along the magnetic field direction within a high-temperature ionized gas are computed by use of a new conductivity tensor. It is found that phase changes and Landau diffusion damping resulting from electron drift become important for certain ranges of the parameters. These effects are enhanced by the resonance that occurs near the electron-cyclotron frequency. The refractive indices depend sensitively upon electron density and temperature.

538.566.2 : 551.51 : 532.517.4

E.M. WAVE SCATTERING. SPACE–TIME CORRELATIONS IN STATIONARY ISOTROPIC TURBULENCE. See Abstr. 2127

538.566.2 : 537.56

CONDUCTIVITY OF PLASMAS TO MICROWAVES. See Abstr. 2435

538.566.2 : 534.26

2542. SCATTERING OF PLANE WAVES BY LOCALLY HOMOGENEOUS DIELECTRIC NOISE. R.A.Silverman.
Proc. Cambridge Phil. Soc., Vol. 54, Pt 4, 530-7 (Oct., 1958).

In a discussion of the scattering of acoustic and electromagnetic radiation by random refractive index fluctuations (noise), an attempt is made to provide a rigorous description of processes which are locally homogeneous, although not homogeneous in the large. For observations in the Fraunhofer region it is found that the local structure of the noise determines the average scattered power received at a fixed point, whereas the overall structure of the noise determines the space correlations of the radiation received at two different points. R.A.Newing

538.566.2

2543. INCIDENCE OF A PLANE ELECTROMAGNETIC WAVE ON AN ELECTRON GAS IN UNIFORM MOTION THROUGH A DIELECTRIC MEDIUM. A.Battig.
Rev. Univ. Tucuman A, Vol. 11, No. 1-2, 110-19 (1957). In Spanish.

The variation of the effective dielectric constant with electron density is discussed. For electron velocities v less than the phase velocity V of electromagnetic waves in the medium, the transmitted wave is shown to be attenuated above a critical electron density. It is also shown that, for $v > V$, the phase velocity of the transmitted wave has a singularity at a critical density. R.A.Newing

538.566.2 : 537.56

2544. ON THE PROPAGATION OF LONG ELECTRIC WAVES IN A MAGNETIZED PLASMA AND THEIR TRANSMISSION THROUGH PLASMA LAYERS. W.O.Schumann.
Z. angew. Phys., Vol. 10, No. 9, 428-33 (Sept., 1958). In German.

The propagation of plane electromagnetic waves of small frequency ω is considered when allowance is made for collision damping. For sufficiently small ω, the plasma behaves as a conductor for waves propagated perpendicular to the magnetic field, and also for propagation in the direction of the field in the case of small electron cyclotron frequencies Ω. For large Ω, the propagation in the direction of the field of the two wave types is considered. Reflection and transmission at an air–plasma interface are discussed, and also transmission through a plasma strip of finite thickness. R.A.Newing

538.566.2 : 539.2

ELECTROMAGNETIC WAVES IN A CRYSTAL WITH EXCITONS See Abstr. 1856

538.566.3 : 621.396.812.3

2545. FARADAY FADING OF EARTH SATELLITE SIGNALS.
F.B.Daniels and S.J.Bauer.
Nature (London), Vol. 182, 599 (Aug. 30, 1958).

It is pointed out that the complete expression for the rate of fading of earth satellite signals caused by the ionospheric Faraday effect involves a term in N (the electron density at the satellite) due to the radial velocity component of the satellite, in addition to the term in $\int$Ndh. Neglect of the first term may account for the abnormally high values of $\int$Ndh obtained from satellite measurements.

G.M.Brown

NUCLEAR AND ATOMIC PHYSICS APPARATUS . PARTICLE DETECTORS

539.1.07

2546. THE EFFECT OF THE DISCHARGE ON THE RESISTANCE OF THIN CATHODES IN GEIGER—MULLER COUNTERS.
A.Eckardt and U.Heinecke.
Naturwissenschaften, Vol. 45, No. 14, 331-2 (1958). In German.

Measurements were made with argon—ethyl alcohol fillings and a thin cathode layer (thickness about 1 μ). The resistance of the cathode decreased with time; details are shown graphically.

J.D.Craggs

539.1.07

2547. FACTORS AFFECTING THE APPLICATION OF HALOGEN-QUENCHED G—M TUBES. W.G.Egan.
I.R.E. Trans Nuclear Sci., Vol. NS-3, No. 3, 22-4 (June, 1956).

Pulses obtained from tubes operated under minimum circuit loading conditions were investigated. Oscillograms are shown and pulse characteristics discussed. The data show that the plateau obtained is determined, in part, both by the pulse shapes and by the electrical characteristics of the associated equipment. Spurious peaks in the halogen-quenched pulses occurring at normal operating voltages may be registered as counts, at certain voltage discrimination levels and circuit resolving times. This is of practical importance in radiation measurements.

539.1.07

2548. MERCURY-VAPOR PROPORTIONAL COUNTERS.
C.W.McCutchen.
Rev. sci. Instrum., Vol. 29, No. 12, 1139-40 (Dec., 1958).

A mercury-vapour filled proportional counter is described. Its behaviour as a γ-counter is investigated. The resolution is fair (7.5% energy spread at 60 keV); however, the various mercury X-ray fluorescence yields and absorption cross-sections combine to make the output spectrum of the counter complex and difficult to interpret. It is found that the output pulses are slow, rising in about 30 μsec, though this can be reduced to about 8 μsec by addition of CO to the filling.

539.1.07

2549. THE IONIZATION CHAMBER AS AN INSTRUMENT FOR THE CONTINUOUS RECORDING OF COSMIC RADIATION.
W.Messerschmidt.
Exper. Tech. der Phys., Vol. 6, No. 4, 145-56 (1958). In German.

Four chambers have been working satisfactorily at Halle since 1956 without interruption. Their volume is 20 litres containing nitrogen at 22 atm. A compensation method is employed. The residual current in the chamber is 1.7×10^{-14} A. In the case of the measurements carried out during the International Geophysical Year the fluctuations of the chambers were less than ±0.3% per hour.

E.W.Kellermann

539.1.07

2550. INTEGRATING IONIZATION CHAMBERS.
J.L. de Briones Viejobueno.
Rev. Geofis., Vol. 17, No. 66, 173-212 (April-June, 1958).
In Spanish.

A description of apparatus used for α-particle studies at the Institute of Applied Physics (Madrid?), and of the experimental methods employed, mainly to calculate the amount of uranium contained in natural samples.

L.Pincherle

539.1.07

2551. INTRINSIC SCINTILLATOR RESOLUTION.
G.G.Kelley, P.R.Bell, R.C.Davis and N.H.Lazar.
I.R.E. Trans Nuclear Sci., Vol. NS-3, No. 4, 57-8 (Nov., 1956).

Measurements of spectrometer resolution using an electron gun and phosphor type of light source yield values considerably better than those obtained from scintillations in a phosphor. Line widths of about 3.4 per cent were obtained at a pulse height equivalent to 661 keV in NaI. An investigation is being made to determine the causes of this difference. A number of possibilities have been eliminated. Flasher light pulses may be collimated or diffused at the photo-surface with no difference in result. They may be mixed with random scintillation pulses giving simultaneously the relatively poor resolution of the scintillator and the good resolution of the flasher. Optical filters do not affect the result when the flasher is used, but do give a relative improvement with a scintillator. It is found that as the light is attenuated in any way from a scintillation crystal, its relative resolution is improved. The improvement is compatible with the concept of an intrinsic crystal resolution. In other words, the difference of the squares of crystal width and flasher width remains constant with varying attenuation. It remains constant also for a given crystal with photomultipliers of different types and resolutions. The intrinsic width indicated for a good crystal is about 6 per cent. Results of experiments attempting to locate the cause of this effect are reported.

539.1.07

2552. IN VIVO GAMMA MEASUREMENTS AT VERY LOW LEVELS WITH 4π LIQUID SCINTILLATION DETECTORS.
E.C.Anderson.
I.R.E. Trans Nuclear Sci., Vol. NS-3, No. 4, 96-102 (Nov., 1956).

A large 4π liquid scintillation counter for the rapid measurement of total internal gamma contamination of the human body at concentrations 1000 times less than the maximum permissible levels is described. A counting time of only 100 sec per subject is required to obtain a sensitivity of 5×10^{-10} c for 1.5 MeV gamma-rays. Because of the high counting efficiency and the great stability of operation, the magnitude of counter background is of comparatively little importance so that elaborate shielding precautions are not required. Energy resolution is sufficient to distinguish between gamma rays of markedly different energy, but not adequate for the identification of individual nuclides. The operating characteristics of the counter are discussed including the spectrum and stability of background, energy resolution, and the spectra and limits of sensitivity for nuclides of interest in connection with nuclear power stations and uranium mining operations.

539.1.07 : 535.376

CsI AS ALPHA-SCINTILLATION PHOSPHOR. See Abstr. 2227

539.1.07 : 535.81

TRANSMISSION CHARACTERISTICS OF LIGHT PIPERS. See Abstr. 2252

539.1.07 : 535.33.07 : 537.531

SCINTILLATION SPECTROMETRY OF CONTINUOUS X-RAYS. See Abstr. 2388

539.1.07

2553. RELATIVE SCINTILLATION INTENSITY OF SOME CERENKOV COUNTER MEDIA. R.Madey and L.Leipuner.
I.R.E. Trans Nuclear Sci., Vol. NS-3, No. 4, 61-2 (Nov., 1956).

Selected transparent media were bombarded with a 40 MeV alpha-particle beam. The ratio of the photomultiplier output current to the alpha-particle beam current was taken as a measure of the relative scintillation intensity. The output current from an RCA type 6342 photomultiplier was read on a 50 μA (full scale)meter. The alpha particle beam current was monitored by counting alpha particles elastically scattered from a 0.005 in. gold foil. Preliminary results on the light output from some media relative to that for distilled water are tabulated. Background appeared to give negligible contribution to the scintillation intensity. The background measurement was made by stopping the alpha beam with a $\frac{1}{16}$ in. aluminium plate inserted ahead of the substance studied.

539.1.07 : 537.533.1

A VARIABLE-PRESSURE GAS CHERENKOV COUNTER. See Abstr. 2397

539.1.07 : 535.345 : 539.89

EFFECT OF PRESSURE ON PROPERTIES OF DIAMOND COUNTERS. See Abstr. 1914

539.1.07

2554. RECENT NEUTRON DETECTOR STUDIES AT ARGONNE NATIONAL LABORATORY.
G.F.Erickson, S.G.Kaufmann and L.E.Pahis.
I.R.E. Trans Nuclear Sci., Vol. NS-3, No. 3, 8-10 (June, 1956).

A neutron-sensitive photomultiplier tube was constructed and tested in line with a programme to investigate unconventional mechanisms of neutron detection. A fission counter following established principles was designed with emphasis on minimum demands on skill and labour during construction and assembly, and minimum over-all cost.

539.1.07

2555. PHOTOMULTIPLIER COUNTERS IN HIGH-ENERGY PHYSICS EXPERIMENTS. B.J.Moyer.
I.R.E. Trans Nuclear Sci., Vol. NS-3, No. 4, 107-11 (Nov., 1956).

Techniques in the use of photomultipliers in high-energy nuclear physics are presented by the description of experiments that have been prominent recently. The applications involve the use of photomultipliers with attendant amplification at the limit of present possibilities of time resolution. Such applications include measurements of time-of-flight, measurement of lifetime of heavy unstable particles, and the elimination of background effects in the pulsed radiation fields of high-energy accelerators. The need for the development of large fast-rising signals from events of small light output, such as Cherenkov light pulses, is made apparent, and a discussion of the performance desired from electron multipliers in view of contemplated experiments is presented.

539.1.07

2556. GRAPHICAL METHOD FOR THE ANALYSIS OF BUBBLE CHAMBER PICTURES. V.Borelli, P.Franzini, I.Mannelli, A.Minguzzi-Ranzi, R.Santangelo, F.Saporetti, V.Silvestrini, P.Waloschek and V.Zoboli.
Nuovo Cimento, Vol. 10, No. 3, 525-30 (Nov. 1, 1958).

A simple method for the analysis of bubble chamber pictures is described. It is sufficiently precise for most work and has been successfully used during the last year. Some details of practical interest are included.

539.1.07

2557. THE USE OF METHYL IODIDE—PROPANE MIXTURES AND TRI-FLUORO BROMO METHANE AS BUBBLE CHAMBER FLUIDS. F.W.Bullock, C.Dodd and G.E.Kalmus.
Nuovo Cimento, Vol. 10, No. 4, 718-20 (Nov. 16, 1958).

The suitability of a methyl iodide—propane system as a "heavy liquid" bubble-chamber medium was investigated. Operating conditions were found for various mixtures, and also for tri-fluoro bromo methane, another possible heavy liquid medium.

539.1.07

2558. PHOTOMETRIC ANALYSIS OF THE TRACKS IN THE NUCLEAR EMULSIONS. III. EFFECT OF THE DEVELOPMENT ON THE PHOTOMETRIC WIDTH.
P.G.Bizzeti, M.G.Dagliana, M.Della Corte and L.Tocci.
Nuovo Cimento, Vol. 10, No. 2, 388-92 (Oct. 16, 1958).

For Pt II, see Abstr. 1148 (1958). The dependence of the photometric width of a track on the degree of development was investigated in G-5 nuclear plates, developed by the standard procedure. It is found that the width varies with the development only through an additive term, which is independent of the nature and velocity of the particle which produced the track.

539.1.07 : 778.34

THE LOADING OF NUCLEAR EMULSIONS WITH PHOSPHORS BY MEANS OF ABSORPTION. See Abstr. 1994

539.1.07 : 539.17

APPARATUS FOR SUM-COINCIDENCE METHOD OF STUDYING NUCLEAR REACTIONS. See Abstr. 1762

539.1.07 : 537.543

CYCLOTRON BEAM INTENSITY MEASUREMENTS.
See Abstr. 2428

ELEMENTARY PARTICLES

539.12 : 519.2

2559. AGE-DEPENDENT BRANCHING STOCHASTIC PROCESSES IN CASCADE THEORY. II. W.M.Woods and A.T.Bharucha-Reid.
Nuovo Cimento, Vol. 10, No. 4, 569-78 (Nov. 16, 1958).

A simple model of an electron—photon cascade is considered in which the transformation probabilities are functions of absorber depth. The mean and variance of the number of electrons in the cascade as a function of absorber depth are obtained and their properties discussed. An equation which yields the probability that the cascade will eventually terminate is also given. For previous part see Abstr. 685 (1955).

539.12

2560. USEFUL DIAGRAM. G.D.Freier.
Amer. J. Phys., Vol. 26, No. 8, 567-8 (Nov., 1958).

The relations between many of the parameters in nuclear scattering problems are shown in a simple geometrical construction.

539.12 : 539.17

EIGENPHASESHIFTS IN TERMS OF WIGNER'S NUCLEAR REACTION THEORY. See Abstr. 1760

539.12 : 539.17

2561. ON THE HYDRODYNAMICAL THEORY OF MULTIPLE PRODUCTION OF PARTICLES. G.A.Milekhin.
Zh. eksper. teor. Fiz., Vol. 35, No. 4(10), 978-81 (1958). In Russian.

The problem of symmetry in the angular and energy distributions of secondary particles produced in collisions between a nucleon and nucleus or between two nuclei is considered on the basis of the hydrodynamical theory of multiple production of particles. It is shown that symmetry of this type exists in a special coordinate system which is close to the c.m.s.

539.12

2562. ELASTIC SCATTERING OF PHOTONS ON EXCITED NUCLEONS. N.F.Nelipa.
Zh. eksper. teor. Fiz., Vol. 35, No. 3(9), 662-7 (1958). In Russian.

The cross-section for elastic scattering of γ-quanta on nucleons was computed allowing for the excited states of nucleons, as described by the Markov model. The calculated cross-section values are found to agree satisfactorily with the available experimental data.

539.12 : 539.166

2563. GAMMA-RADIATION ABSORPTION COEFFICIENTS OF AIR IN THE ENERGY RANGE 0.01 TO 100 MeV. J.W.Allison.
J. appl. Phys., Vol. 29, No. 8, 1175-8 (Aug., 1958).

Two simple formulae are given which enable the total mass absorption coefficient of air to be readily calculated. These formulae, which are derived from published theoretical values of the total coefficient, are applicable to the energy ranges 0.01 to 100 MeV and 0.05 to 10 MeV, and yield results which agree with the theoretical values to within about 5% and 1%, respectively. Comparison is made with values calculated from existing empirical formulae which cover energies up to about 1 MeV.

539.12

2564. POLARIZATION OF ELASTICALLY SCATTERED GAMMA-RAYS. I.Lovas.
Nuclear Phys., Vol. 8, No. 2, 155-6 (Sept. [2], 1958).

A formula is given for the polarization of gamma rays due to elastic scattering, including the effects of Delbrück scattering.
P.G.Murphy

539.12 : 535.14

FLUCTUATIONS OF PHOTON BEAMS AND THEIR CORRELATIONS. See Abstr. 2188

539.12

2565. POLARIZATION EFFECTS IN INTEGRATED BREMSSTRAHLUNG CROSS-SECTION. H.Banerjee.
Phys. Rev., Vol. 111, No. 2, 532-4 (July 15, 1958).

The Born approximation bremsstrahlung cross-section, summed over the outgoing electron's spin states and integrated over its momentum directions, is obtained for arbitrary polarizations of the initial electron and the outgoing photon. A brief discussion is given of the way in which the photon polarization depends on that of the incident electron.

539.12

2566. POLARIZATION OF BREMSSTRAHLUNG FROM POLARIZED ELECTRONS. C.Fronsdal and H.Überall.
Phys. Rev., Vol. 111, No. 2, 580-6 (July 15, 1958).

The polarization of bremsstrahlung emitted from polarized electrons is analysed in the Born approximation. Spins of the final electron are summed over. Differential cross-sections are given, and are integrated over final electron directions. The results are valid for all electron energies, subject only to the limitations on the validity of the Born approximation. Screening is taken into account by using an exponential atomic form factor. Methods for relativistic spin description are discussed.

539.12

2567. CIRCULAR POLARIZATION OF EXTERNAL BREMSSTRAHLUNG PRODUCED BY BETA RAYS.
S.Galster and H.Schopper.
Phys. Rev. Letters, Vol. 1, No. 9, 330-2 (Nov. 1, 1958).

It is found that the production of circularly polarized bremsstrahlung by β-rays in thick absorbers can be understood quantitatively if the electron energy distribution is taken into account. The results are compared with experimentally determined values.
C.J.Batty

539.12

2568. CIRCULAR POLARIZATION OF EXTERNAL BREMSSTRAHLUNG. A.Bisi and L.Zappa.
Phys. Rev. Letters, Vol. 1, No. 9, 332-3 (Nov. 1, 1958).

The sense and the degree of the polarization of external bremsstrahlung quanta, emitted by the β-electrons originating from Y^{90}, were measured as a function of their energy; and, after applying several corrections, the results are compared with a rough theoretical estimation, giving good agreement. P.Roman

539.12

2569. RADIATIVE CORRECTIONS TO BREMSSTRAHLUNG.
P.I.Fomin.
Zh. eksper. teor. Fiz., Vol. 35, No. 3(9). 707-18 (1958). In Russian.

Radiative corrections to the differential cross-section for bremsstrahlung are computed with aid of the mass operator method. A general formula is obtained and some limiting cases are considered.

539.12

2570. BREMSSTRAHLUNG OF π^{+-}-MESONS INTERACTING WITH NUCLEI. M.F.Lomanov, A.G.Meshkovskiĭ, Ya.Ya.Shalamov, V.A.Shebanov and A.F.Grashin.
Zh. eksper. teor. Fiz., Vol. 35, No. 4(10), 887-93 (1958). In Russian.

Nuclear-force bremsstrahlung of π^{+-}-mesons was observed in a Freon bubble chamber during the interaction between 80-300 MeV π^{+-}-mesons with carbon, fluorine and chlorine nuclei. The bremsstrahlung cross-section in inelastic and elastic scattering of π^{+-}-mesons, deduced from 20 observed events, was $(4.5 \pm {}^{1.2}_{2.0}) \times \times 10^{-27}$ cm^2 per fluorine nucleus in the indicated energy region Three events of bremsstrahlung were detected in the absorption of π^{+-}-mesons by a nucleus and two cases can be ascribed to bremsstrahlung in charge-exchange scattering of π^{+-}-mesons on a nucleus. The bremsstrahlung cross-section for various nuclear processes was computed in the quasiclassical approximation. The values of the cross-sections computed from these formulae are in good agreement with the experimental results.

539.12

2571. ON THE SUBJECT OF THE VISIBLE AND ULTRAVIOLET LUMINESCENCE RADIATION PRODUCED IN AQUEOUS AND ORGANIC MEDIA SUBJECTED TO RADIATIONS OF HIGH QUANTUM ENERGY. L.Mallet.
C.R. Acad. Sci. (Paris), Vol. 247, No. 18, 1449-50 (Nov. 3, 1958).
In French.

The author claims to have discovered the radiation now associated with the name of Cherenkov, some eight years earlier than the latter worker and to have distinguished it from normal luminescence. He points out that the original contribution in Cherenkov's work was a study of the polarization of the radiation emitted under γ-ray excitation. G.F.J.Garlick

539.12

2572. CHERENKOV RADIATION EMITTED BY A CHARGED PARTICLE PASSING THROUGH A FERRODIELECTRIC SUBSTANCE [A FERRITE]. V.G.Bar'yakhtar and M.I.Kaganov.
Zh. eksper. teor. Fiz., Vol. 35, No. 3(9), 766-70 (1958). In Russian.

Cherenkov radiation from a charged particle moving in a medium with a gyrotropic magnetic permeability is considered. Losses due to excitation of spin waves by the particle are calculated.

539.12 : 537.591.15

CHERENKOV RADIATION OF COSMIC-RAY SHOWERS. See Abstr. 2463

539.12

2573. ON THE HELICITY OF NEUTRINOS.
I.Marklund and L.A.Page.
Nuclear Phys., Vol. 9, No. 1, 88-93 (Nov. [3], 1958).

In order to determine the helicity of neutrinos the authors measured the sign and magnitude of polarization of γ-rays emitted in opposite direction to the neutrinos. The 963 keV γ-ray following electron-capture by Eu^{152m} is thus measured to be 80 ± 30% circularly polarized with negative helicity. This result is in agreement with the measurement and conclusion by Goldhaber et al. (Abstr. 2461/1958) that the emitted neutrino has negative helicity, $\vec{\sigma} \cdot \vec{p} = -1$ in this orbital electron capture.

539.12

2574. ON COROLLARIES FROM THE TWO-COMPONENT NATURE OF THE ELECTRON IN β-INTERACTIONS.
B.L.Ioffe and V.A.Ljubimov.
Nuovo Cimento, Vol. 10, No. 2, 355-8 (Oct. 16, 1958).

A necessary and sufficient condition for the value v/c of the longitudinal polarization of the electron is discussed.

539.12

2575. ON THE INTERACTION BETWEEN THE ELECTRON AND OTHER PARTICLES AT SHORT RANGES.
N.N.Kolesnikov and Zh.A.Zhakobi.
Zh. eksper. teor. Fiz., Vol. 35, No. 2(8), 381-91 (1958). In Russian.

The possibility of existence of an electron structure and its description from the viewpoint of the linear theory of extended particles and also of the non-linear theory are discussed. Both theories lead to close results for the interaction between the electron and proton, neutron and light nuclei; however according to the non-linear theory the interaction between two electrons at very small distances should appreciably differ from that between an electron and a positron.

539.12 : 537.54

COHERENT RADIATION OF ELECTRONS IN A SYNCHROTRON. See Abstr. 2426

539.12 : 530.145

2576. APPLICATION TO ELECTRON SCATTERING OF CENTER-OF-MASS EFFECTS IN THE NUCLEAR SHELL MODEL.
L.J.Tassie and F.C.Barker.
Phys. Rev., Vol. 111, No. 3, 940 (Aug. 1, 1958).

The usual shell-model treatment of the nuclear scattering of high-energy electrons neglects the motion of the centre of mass of the nucleus. The correction due to this is calculated for the case of an oscillator potential well and gives a simple additional factor multiplying the nuclear form factor.

539.12 : 539.18

THE ADIABATIC THEORY IN ELECTRON—ATOM COLLISION CALCULATIONS. See Abstr. 1812

539.12

2577. ENERGY LOSSES OF ELECTRONS IN MEDIA WITH SPATIAL DISPERSION. V.M.Agranovich and A.A.Rukhadze.
Zh. eksper. teor. Fiz., Vol. 35, No. 5(11), 1171-4 (1958). In Russian.

A general formula was obtained for the energy losses of an electron moving in an arbitrary anisotropic medium with space dispersion. It is shown in the nonrelativistic case that the total energy losses in an isotropic medium do not change when space dispersion of the medium is taken into account, whereas losses on the excitation of a transverse wave may, in general, change. If space dispersion of the medium is taken into account Cherenkov radiation of frequency ω is found to be distributed over the surfaces of several cones. The intensity of the radiation is calculated.

539.12 : 538.114

2578. ON THE POLARIZATION OF FREE ELECTRONS.
S.Yamaguchi.
Naturwissenschaften, Vol. 145, No. 14, 332-3 (1958). In German.

A classical treatment of the results of an experiment by the same author, in order to evaluate the strength of the Weiss magnetic field in a ferromagnetic substance. G.Martelli

539.12

2579. ENERGY DEPENDENCE OF THE ANGULAR CORRELATION OF POSITRONS FROM THE $\pi \to \mu \to e$ DECAY.
Kh.P.Babayan, N.A.Marutyan, K.A.Matevosyan and M.G.Sarinyan.
Zh. eksper. teor. Fiz., Vol. 35, No. 3(9), 561-4 (1958). In Russian.

The energy dependence of the angular correlation of positrons was investigated for 405 $\pi \to \mu \to e$ decay events in nuclear emulsions. The experimental energy dependence of the backward—forward ratio for the emitted positrons agrees with the predictions of the two-component neutrino theory.

539.12

2580. TEMPERATURE EFFECT ON POSITRON ANNIHILATION IN CONDENSED MATTER. R.L.de Zafra and W.T.Joyner.
Phys. Rev., Vol. 112, No. 1, 19-29 (Oct. 1, 1958).

An experimental investigation has been made of the temperature effect on the angular distribution of radiation from positron annihilation in matter. The materials chosen were Teflon, fused quartz, naphthalene, and water, for which the most comprehensive studies of the long-lifetime (τ_2) component and its intensity under various conditions have previously been made. The correlation between τ_2 lifetime and intensity and the amount of narrow component in the angular distribution has been studied both in a single phase, and as a function of phase change. Evidence seems conclusive that the so-called temperature effect on angular distributions is in reality a density effect. The underlying cause of the narrow-component enhancement seems in part to be related simply to an increase in positronium production which follows density changes. In quartz, and in water, Teflon, and naphthalene within the present limits of error, the enhancement may be attributed to this cause alone. The narrow component in quartz, Teflon, and naphthalene is found to have a width corresponding to a centre-of-mass energy at the time of annihilation of about 10 times the thermal energy for positronium. The water—ice transition shows extremely interesting properties, marked by the appearance of a very narrow and well defined peak in the ice phase. It is suggested this is due to a reduction of the zero-point energy caused by enlargement of cavities in which positronium is trapped. Some anomalies are pointed out in the existing τ_2 intensity, lifetime, and 3γ annihilation rate as a function of phase change in water.

539.12

2581. ELECTRON—POSITRON PAIR ANNIHILATION AT ARBITRARY POLARIZATIONS. S.G.Rohoziński.
Bull. Acad. Polon. Sci. Ser. Sci. math. astron. phys., Vol. 6, No. 10, 619-26 (1958).

The cross-section for two-quantum annihilation of arbitrarily polarized electrons and positrons is calculated; the detection of positron polarization by this process is discussed.

R.J.N.Phillips

539.12 : 539.2

2582. THE INFLUENCE OF A MAGNETIC FIELD ON THE LIFETIME OF POSITRONIUM IN SOLIDS. D.Freytag and K.Ziock.
Z. Phys., Vol. 153, No. 1, 124-8 (1958). In German.

In solids, one finds a long-lived component of positrons, which can be related to the formation of triplet positronium. The lifetime of this long-lived component is measured in polystyrene and the influence of a magnetic field on this lifetime is determined. It turns out to be in agreement with the value calculated from the Zeeman effect in positronium.

G.E.Brown

539.12

2583. THE QUENCHING OF TRIPLET POSITRONIUM BY IONS IN AQUEOUS SOLUTIONS. R.E.Green and R.E.Bell.
Canad. J. Phys., Vol. 36, No. 12, 1684-95 (Dec., 1958).

Measurements of positron lifetimes in aqueous solutions was performed using a fast time-to-amplitude converter with a resolving time of $\sim 10^{-9}$ sec. The lifetime, τ_2, of the long-lived component of the complex decay observed in water was found to decrease when paramagnetic salts are added. The experimental results are interpreted in terms of "pickoff" annihilation to explain the observed τ_2 in pure water, and a rapid triplet ↔ singlet conversion process to account for the quenching of the τ_2 component. The conversion is caused by the presence of unpaired electrons in the structure of the paramagnetic atoms. Triplet → singlet conversion cross-sections were calculated on the basis of this interpretation and they range from 4.0×10^{-20} cm^2 for NdCl$_3$ to 3.8×10^{-18} cm^2 for FeCl$_3$.

539.12 : 539.2

2584. EXISTENCE OF POSITRONIUM IN SOLIDS. M.A.B.Bég.
Phys. Rev., Vol. 111, No. 4, 1062-3 (Aug. 15, 1958).

It is shown that it is impossible, in principle, to detect excited states of positronium within a solid or diffusing out of a solid. An experiment is proposed which would decide directly whether ground state positronium may be formed in a solid.

539.12

2585. ELECTROMAGNETIC STRUCTURE OF THE NUCLEON.
P.Federbush, M.L.Goldberger and S.B.Treiman.
Phys. Rev., Vol. 112, No. 2, 642-65 (Oct. 15, 1958).

The electromagnetic structure of the nucleon is studied by using dispersion relation techniques. Contributions to the magnetic moments and mean square radii from the two-pion intermediate state are studied exhaustively. It is shown that the electromagnetic structure of the meson itself may play an important role here; this structure is also discussed. The two-pion state seems to account reasonably for the isotopic vector magnetic moment and magnetization mean square radius, but the charge-density radius appears to be much smaller than the currently accepted experimental value. As regards the isotopic scalar properties of the nucleon, we have studied the contributions from intermediate states with two K mesons and nucleon-antinucleon pairs (more generally baryon pairs). The K-meson state is treated by perturbation theory and found to have a small effect. By use of an argument based on the unitarity of the S matrix, it is shown that the pair contributions must be small. Certain general properties of the three-pion state, believed to be the most important contributor to isotopic scalar quantities, are discussed; but we are unable to make any quantitative statements.

539.12

2586. EFFECT OF STRANGE PARTICLES ON MAGNETIC MOMENTS OF NUCLEONS. S.N.Gupta.
Phys. Rev., Vol. 111, No. 5, 1436-8 (Sept. 1, 1958).

The effect of heavy mesons and hyperons on the anomalous magnetic moments of nucleons is discussed. The present investigation suggests that (a) K-mesons behave as pseudoscalar particles in strong interactions, and (b) there exists a hitherto unobserved highly unstable heavy neutral scalar meson, which is coupled strongly to the nucleons.

539.12

2587. ON RELATIONSHIPS BETWEEN NUCLEON—NUCLEON AND NUCLEON—ANTINUCLEON SCATTERING AMPLITUDES AT HIGH ENERGIES. F.M.Kuni.
Vestnik Leningrad. Univ., (1958), No. 16, Ser. Fiz. Khim., No. 3, 24-6. In Russian.

The author discusses the elastic scattering relationships to which the dispersion relationships reduce for high energies.

C.R.S.Manders

539.12

2588. NEUTRON—PROTON INTERACTION. Y.P.Varshni.
Nature (London), Vol. 182, 1726-8 (Dec. 20, 1958).

Suggests this interaction is simply magnetic.

R.J.N.Phillips

539.12

2589. PROTON GYROMAGNETIC RATIO.
R.L.Driscoll and P.L.Bender.
Phys. Rev. Letters, Vol. 1, No. 11, 413-14 (Dec. 1, 1958).

The proton gyromagnetic ratio was measured from the free precession frequency of protons in water and in benzene in a field of 12 gauss produced by a precession solenoid after prepolarization at 5000 gauss and a 90° pulse, to 1 in 10^7. The result, for water, uncorrected for diamagnetism, is $\gamma_p = (2.67513 \pm 0.00002) \times 10^4$ gauss^{-1} sec^{-1}. More reliable results are awaited but it is thought that this new determination will eventually entail a revision of some of the fundamental constants.

J.G.Powles

539.12

2590. HELICITY OF THE PROTON FROM Λ^0 DECAY.
E.Boldt, H.S.Bridge, D.O.Caldwell and Y.Pal.
Phys. Rev. Letters, Vol. 1, No. 7, 256-8 (Oct. 1, 1958).

Λ^0 hyperons were produced in a multiplate cloud-chamber exposed to 1.2-1.9 BeV negative pions from the cosmotron. Longitudinal polarization of the decay protons could be detected by nuclear scattering owing to the proton momentum vector being different from the polarization vector in the laboratory system for decays in flight. The analyser strength of iron (the plate material) for proton scattering at the momenta appropriate to this experiment was assumed from other work. A maximum likelihood analysis of 54 proton—iron scattering events gave a polarization $\sigma = -0.85^{+0.15}_{-0.21}$ This is the first example of a weak decay not involving neutrinos to give a negative helicity. R.H.W.Johnston

539.12

2591. THE EVALUATION OF THE VACUUM POLARIZATION EFFECTS ON SCATTERING PHASE SHIFTS.

E.Eriksen.

Avhandl. Norske VidenskAkad. Oslo I., 1957, No. 4, 19 pp.

This gives the mathematical details of the calculation of the contribution to low energy p—p scattering from the Schwinger (Abstr. 6751/1950) vacuum polarization potential, which is treated in Born approximation. The results were announced previously (Abstr. 7961/1956) J.C.Taylor

539.12

2592. PROTON—PROTON SCATTERING IN THE BeV REGION.

G.E.Brown.

Phys. Rev., Vol. 111, No. 4, 1178-81 (Aug. 15, 1958).

Analysed in terms of an interaction which, at 1 BeV, is taken to be a hard core of radius 0.45×10^{-13} cm together with an external absorption of Gaussian form. The hard core is assumed to disappear with increasing energy and to be replaced by absorption. General features of the data are well reproduced by this simple model.

539.12

2593. DIFFRACTION SCATTERING OF 6.15 BeV PROTONS ON PROTONS.

V.G.Grishin.

Zh. eksper. teor. Fiz., Vol. 35, No. 2(8), 501-4 (1958). In Russian.

A phase-shift analysis is carried out. The spatial distribution of the absorbing field is deduced from the results of an analysis in the quasi-classical approximation. The value 0.79×10^{-13} cm is obtained for the mean square proton—proton nuclear interaction range.

539.12

2594. ASYMMETRY IN SCATTERING OF 150 MeV POLARIZED PROTONS IN NUCLEAR EMULSIONS.

B.T.Feld and B.C.Maglić.

Phys. Rev. Letters, Vol. 1, No. 10, 375-7 (Nov. 15, 1958).

A new technique is described using measurements of the distribution of the projected angles of selected tracks, near the point of entry and after a given distance in the emulsion. For 5°-12° scatters the polarization was found to be 0.60 ± 0.06 for an average energy of 135 MeV (initial polarization 0.72 ± 0.03). For angles near 2° a negative polarization −0.16 ± 0.10 was found, indicating interference between the Coulomb scattering and nuclear spin—orbit interaction. E.J.Burge

539.12

2595. A SPECTROMETER FOR PROTONS.

G.Marcazzan, A.M.Sona and M.Pignanelli.

Nuovo Cimento, Vol. 10, No. 1, 155-9 (Oct. 1, 1958).

Describes a spectrometer for protons of energy between 2 and 14 MeV. This spectrometer is particularly suitable for the study of protons emitted by nuclei bombarded with 14 MeV neutrons. The background of this instrument is particularly low. The resolution of the instrument is discussed.

539.12

2596. INVESTIGATION OF TIME-REVERSAL INVARIANCE IN THE BETA DECAY OF THE NEUTRON.

M.A.Clark, J.M.Robson and R.Nathans.

Phys. Rev. Letters, Vol. 1, No. 3, 100-1 (Aug. 1, 1958).

A beam of thermal neutrons, obtained by passing a beam from the N.R.X. reactor through a quartz filter, passed through a steel block into a vacuum tank, and was monitored by a fission chamber. An estimated beam polarization of 27% could be obtained by producing a flux of 16 000 gauss in the steel block. Neutron decays in the vacuum tank were observed by simultaneous detection of recoil protons and decay electrons, two electron counters being used to detect particles in two directions at 160° to the proton direction. Coincidences between the proton counter and the two electron counters separately were recorded, and the difference between the two coincidence rates was determined for both polarized and unpolarized neutrons. The change in this difference with polarization is related to a time-reversal coefficient, D, which is zero if the β-decay interaction is invariant under time-reversal and is of the order of 0.5 if invariance is completely violated. A preliminary experimental result is D = −0.02 ± 0.28, suggesting that complete violation does not occur. A.E.I. Research Laboratory

539.12

2597. TEST OF TIME-REVERSAL INVARIANCE OF THE BETA INTERACTION IN THE DECAY OF FREE POLARIZED NEUTRONS.

M.T.Burgy, V.E.Krohn, T.B.Novey, G.R.Ringo and V.L.Telegdi.

Phys. Rev. Letters, Vol. 1, No. 9, 324-6 (Nov. 1, 1958).

An experiment was performed to search for a correlation corresponding to the triple scalar product of the neutron polarization, the electron momentum, and the antineutrino momentum. The apparatus was a slight modification of that used previously (Burgy et al., Abstr. 7251/1958). Assuming the currently accepted form of the beta-decay interaction, the result obtained implies that the phase angle, measuring departure from time-reversal invariance, cannot exceed 8°. J.C.Taylor

539.12

2598. MAGNETIC FORM FACTOR OF THE NEUTRON AT 600 MeV.

M.R.Yearian and R.Hofstadter.

Phys. Rev., Vol. 111, No. 3, 934-9 (Aug. 1, 1958).

The study of electrons scattered inelastically from the deuteron has been extended to 600 MeV. Data at 500 MeV were reported in an earlier paper (Abstr. 8977/1958). Results are presented for seven scattering angles between 45° and 135°. A comparison of the deuteron's cross-section at these angles with the corresponding free proton cross-sections permits a determination of the form factor associated with the magnetic moment distribution of the neutron. Two different methods of analysing the data are described, and the r.m.s. radius of the neutron for an exponential density distribution of the magnetic cloud can be shown to lie between the limits of 0.75×10^{-13} cm and 0.95×10^{-13} cm. The r.m.s. radius of the neutron may be taken to be $(0.80 \pm 0.10) \times 10^{-13}$ cm and is very close to the value found for an exponential model of the magnetic cloud in the proton.

539.12 : 539.166.2

ELECTRIC MULTIPOLE RADIATION EMITTED BY A NEUTRON. See Abstr. 1749

539.12 : 539.17

INTERACTION BETWEEN NEUTRONS AND NUCLEI. See Abstr. 1780

539.12 : 538.222

2599. INELASTIC MAGNETIC SCATTERING OF NEUTRONS AT HIGH TEMPERATURES.

P.G. De Gennes.

J. Phys. Chem. Solids, Vol. 4, No. 3, 223-6 (1958).

The magnetic inelastic scattering of neutrons by paramagnetic media with exchange interactions has been studied, using the time-dependent spin correlation functions introduced by Van Hove (Abstr. 556/1955). It is found that the even moments of the energy transfer depend strongly on momentum transfer (for small momentum transfer, all moments go to zero), and on the state of the scatterer (single crystal or powder). The shape and half-width of the spectrum are given as functions of the scattering angle for a polycrystal with nearest-neighbour interactions. The whole study has been confined to the high-temperature region.

539.12

2600. SOLUTION OF A NEUTRON TRANSPORT PROBLEM BY MONTE-CARLO METHOD.

T.Springer.

Z. Naturforsch., Vol. 12a, No. 6, 514-16 (1957). In German.

The energy loss of fast neutrons in heavy metals by inelastic collisions is studied by the Monte-Carlo method. A spherical geometry with central neutron source is assumed, and the collision variables are represented in an electronic computer by internally generated (and tested) random numbers. Neutron space- and energy-distributions are obtained for (a) isotropic scattering, (b) forward scattering. J.W.Gardner

539.12

2601. INVESTIGATION OF NEUTRON DIFFUSION IN GRAPHITE BY A NON-STATIONARY METHOD.

K.H.Beckurts.

Z. Naturforsch., Vol. 11a, No. 10, 880-1 (1956). In German.

The mean life for absorption, the diffusion constant and the related diffusion length for neutrons in a number of large geometrics of graphite are determined by the use of a pulsed neutron source (cf method used by Dardel, Abstr. 7775/1954, 1250/1955). Short neutron pulses were obtained from a tritium target in a 250 kV cascade accelerator. H.C.Cole

539.12

2602. A NEW POSSIBLE THEORY OF THE μ-MESON.

I.Ulehla.

Nuovo Cimento, Vol. 9, No. 4, 679-93 (Aug. 16, 1958).

Presents a theory of the μ-meson as a particle with spin $\frac{1}{2}$ described by anomalous equations differing from the Dirac equations. Calculation is carried out of the intrinsic magnetic moment of the μ-meson, the cross-section for Coulomb and Compton scattering, the self-energy and the electrodynamic correction to the magnetic moment of the μ-meson. An explanation is given of the similarity of the μ-meson and electron at low energies and their dissimilarity at very high energies in electromagnetic interaction. The difference in the masses of the electron and μ-meson is determined by means of the same electromagnetic cut-off for both particles.

539.12

2603. ON THE POLARIZATION OF ELECTRONS FROM THE DECAY OF MUONS.

L.B.Okun and V.M.Šehter.

Nuovo Cimento, Vol. 10, No. 2, 359-64 (Oct. 16, 1958).

An expression for the energy spectrum, angular distribution and polarization of electrons emitted by decaying muons is obtained. The calculations are carried out for a decay interaction Hamiltonian of the most general form characterized by ten complex constants. Results, obtained previously by different authors, are contained in the above expression. It is shown that experiments performed up to the present time are not sufficient for the verification of the predictions made in previous work. To decide which of the formulae is the correct one, the polarization sign of the decaying muons must be measured.

539.12

2604. TIME-REVERSAL INVARIANCE AND RADIATIVE MUON DECAY.

R.H.Pratt.

Phys. Rev., Vol. 111, No. 2, 649-51 (July 15, 1958).

The radiative muon decay $\mu \rightarrow e + \nu + \bar{\nu} + \gamma$ is investigated as a source of information on the time-reversal properties of the muon decay interaction. It is shown that for any muon decay process, which may include electromagnetic interactions, terms in the transition probability which violate time-reversal invariance must be pseudoscalars. Further, only ten combinations of the coupling constants of the four-fermion interaction can occur in the transition probability. These may be classified in accordance with the types of term in which they occur; a term which violates time-reversal invariance must contain as a factor either the electron mass or the transverse electron polarization. In the radiative muon decay, if such a term is proportional to the electron mass, it will also contain as a factor the longitudinal electron polarization.

539.12

2605. ENERGY DEPENDENCE OF μ^+—e^+ DECAY ASYMMETRY.

A.I.Mukhin, E.B.Ozerov and B.Pontekorvo.

Zh. eksper. teor. Fiz., Vol. 35, No. 2(8), 340-7 (1958). In Russian.

The energy dependence of the asymmetry of polarized μ-meson decay electrons was studied with the help of a set of scintillation counters biased against bremsstrahlung. The measurements were carried out for electron energies above 20 MeV. The dependence agrees quantitatively (within a few percent) with that predicted by the two-component neutrino theory. The experiments indicate that the degree of polarization of the μ-meson beam is 0.81 ± 0.11.

539.12 : 537.591.8

2606. KNOCK-ON ELECTRONS FROM COSMIC-RAY μ-MESONS.

J.L.Lloyd and A.W.Wolfendale.

Proc. Phys. Soc., Vol. 73, Pt 2, 178-84 (Feb., 1959).

A cloud-chamber study was made of the electron secondaries produced by fast μ-mesons in iron and lead plates and cloud chamber gas. The mean probability of a meson emerging from a plate accompanied by a single electron was accurately determined for mesons in the momentum range 0.5-200 GeV/c. This probability is 9.0 ± 0.4% for 55 g/cm^2 iron and 5.80 ± 0.15% for 11.5 g/cm^2 lead. A search was made for any anomalous dependence of electron production upon primary momentum or sign of charge but none was detected.

539.12

2607. THE POLARIZATION OF KNOCK-ON ELECTRONS ARISING FROM SCATTERING BY POLARIZED μ-MESONS.

D.Fivel and T.Fulton.

Nuovo Cimento, Vol. 10, No. 4, 682-7 (Nov. 16, 1958).

An experiment is proposed for the direct measurement of the helicity of μ-mesons arising from π-decay by studying the polarization of the high energy electrons produced in the collision of the polarized μ-mesons with unpolarized electrons. Polarization effects become significant only for high energy incident μ's (of the order of a few GeV). The separation of a polarized beam of μ-mesons from the decays in flight of high energy π's is in principle made easier by the fact that the laboratory momenta of μ-mesons which are emitted in the forward and backward directions in the π rest system differ by about 41% as a consequence of the relativistic transformation from the centre of mass to the laboratory system. Expressions in the laboratory frame are also given of the cross-section for scattering polarized electrons by polarized μ-mesons. In the c.m. frame, the results agree with those calculated by Bincer.

539.12 : 530.145

MUON—BARYON SCATTERING. See Abstr. 2091

539.12

2608. PHOTOPRODUCTION OF ELECTRONS AND μ-MESON PAIRS ON NUCLEONS.

I.T.Dyatlov.

Zh. eksper. teor. Fiz., Vol. 35, No. 1(7), 154-8 (1958). In Russian.

Production of electron or μ-meson pairs on nucleons by high high energy γ-quanta is considered. It is shown under what conditions the cross-sections for these processes can be expressed through the electromagnetic form factors of the free nucleon.

539.12

2609. CAPTURE OF μ-MESONS IN DEUTERIUM.

H.Überall and L.Wolfenstein.

Nuovo Cimento, Vol. 10, No. 1, 136-49 (Oct. 1, 1958).

The neutron spectrum, the neutron asymmetry with respect to muon spin direction, and the neutron polarization are calculated as functions of neutron energy for μ-meson capture in deuterium. The total capture rate and the dependence of the rate on the hyperfine state of the mesic atom are given and compared to approximate expressions. The dependence of the observations on the amount of Fermi or Gamow—Teller coupling and on the presence of an effective pseudoscalar coupling is displayed.

539.12

2610. INVESTIGATION OF DEPOLARIZATION OF NEGATIVE μ-MESONS IN LIQUID HYDROGEN.

A.E.Ignatenko, L.B.Egorov, B.Khalupa and D.Chultém.

Zh. eksper. teor. Fiz., Vol. 35, No. 4(10), 894-8 (1958). In Russian.

The angular distribution of decay electrons from μ^--mesons was measured in liquid hydrogen with help of scintillation counters. Within the limits of the experimental errors the distribution was found to be isotropic. The degree of polarization of μ^--mesons in mesic hydrogen was determined from the electron angular distribution data and found to be $< 2.5\%$. The observed complete depolarization of μ^--mesons can evidently be explained in a sufficient degree by the mechanism recently suggested by Zeldovich and Gershtein (1957-58) according to which the μ^--meson jumps from one proton to another simultaneously with the transition to a lower hyperfine-structure state. Due to this mechanism mutual transformation of orthohydrogen and parahydrogen is possible. It is impossible to determine the form of the interaction between μ^--mesons and nucleons by measuring the angular distribution of neutrons from the $\mu^- + p \rightarrow n + \nu$ reaction in liquid hydrogen because of total depolarization of the μ^--mesons.

539.12 : 539.2

2611. ON DEPOLARIZATION OF μ^+-MESONS IN METALS.

I.V.Yakovleva.

Zh. eksper. teor. Fiz., Vol. 35, No. 4(10), 970-3 (1958). In Russian.

Depolarization of μ^+-mesons in a metal is investigated by assuming the formation of mesonium. It is shown that exchange interaction between the mesonium electron and the electron fluid of the metal significantly decreases depolarization of μ^+-mesons. With some reasonable assumptions about the dimensions of mesonium in the metal, the estimates presented are found to be in satisfactory agreement with the experimental data.

539.12 : 539.18

2612. DEPOLARIZATION OF μ^--MESONS IN [MESIC] HYDROGEN, DEUTERIUM AND TRITIUM.

V.B.Belyaev and B.N.Zakhar'ev.

Zh. eksper. teor. Fiz., Vol. 35, No. 4(10), 996-1000 (1958). In Russian.

Some effects which depolarize μ^--mesons in hydrogen, deuterium and tritium are considered. Complete depolarization in hydrogen and tritium occurs before the mesic atom is slowed down to thermal energies. Depolarization probabilities are presented for capture in the K-orbit of a mesic atom and for formation of mesic molecules. A correction $\sim \mu/M$ to account for the motion of the nuclei was applied. The difference in the hyperfine structure levels was taken into account approximately.

539.12 : 537.591.1

POLARIZATION OF COSMIC RAY MUONS. See Abstr. 2460

539.12

613. ON $\pi \to e + \nu + \gamma$ DECAY. V.G.Vaks and B.L.Ioffe.
uovo Cimento, Vol. 10, No. 2, 342-51 (Oct. 16, 1958).

The $\pi \to e + \nu + \gamma$ decay is considered for the case of vector and xial-vector interaction. The assumption that in the vector-variant here is a direct interaction of π-mesons with an electron—neutrino ield as proposed by Gell-Mann and Feynman presents the possibility f establishing an exact relation between the probability of $\to e + \nu + \gamma$ decay, through the vector-variant and the probability f $\pi^0 \to 2\gamma$ decay. As a result, it appears that in the total probability f $\pi \to e + \nu + \gamma$ decay the main role is played by decay through the xial variant, and the ratio of total probability of $\pi \to e + \nu + \gamma$ decay o the probability of $\pi \to \mu + \nu$ decay is of the order of 5×10^{-6}. xpressions for the angular and energy distribution of electrons and uanta are obtained.

539.12

614. EXPERIMENTAL RESULTS ON THE RADIATIVE $-\mu$ DECAY. C.Castagnoli and M.Muchnik.
hys. Rev., Vol. 112, No. 5, 1779-84 (Dec. 1, 1958).

A total of 93045 $\pi-\mu-e$ decays have been examined in Ilford -5 plates, where both the π meson and the μ meson decays take lace in the emulsion, in order to study the $\pi \to \mu + \nu + \gamma$ decay. rom the total number of short muon tracks thus found, all cases ossibly due to pion decays in flight were eliminated. Accurate orrections were carried out taking into account the straggling effects n the normal muons, so as to establish a safe upper limit in the nomalous muon range determination. After carefully correcting for he geometrical losses and experimental biases, the value 1.24 ± 0.25) $\times 10^{-4}$ was obtained for the probability of a pion decaying into a muon whose track is shorter than 435 μ. This result is in air agreement with the theoretical predictions on the pion radiative ecay.

539.12

615. ELECTRON DECAY OF THE PION. T.Fazzini, G.Fidecaro, .W.Merrison, H.Paul and A.V.Tollestrup.
hys. Rev. Letters, Vol. 1, No. 7, 247-9 (Oct. 1, 1958).

Positive pions from the 600 MeV C.E.R.N. synchrocyclotron were elected by a counter telescope and stopped in an absorber. An lectron telescope composed of eight counters separated by graphite nd terminated by a large NaI scintillator was set up facing the absorber at right angles to the pion beam. In the event of a coincidence within ~ 10 pion lifetimes) between the two telescopes all pulse ata was displayed and photographed. 40 $\pi-e$ events were recorded, iving a lifetime of 22 ± 4 mμsec. R.H.W.Johnston

539.12

616. β DECAY OF THE PION. G.Impeduglia, R.Plano, .Prodell, N.Samios, M.Schwartz and J.Steinberger.
hys. Rev. Letters, Vol. 1, No. 7, 249-51 (Oct. 1, 1958).

A liquid-hydrogen magnetic bubble-chamber was exposed to low positive pions of which about 10 were stopped per picture. In n analysis of 65000 decays, 6 clear examples of $\pi-e$ decay were ound, the momentum (70 MeV/c) of the electron being determined o within ~ 3% from track curvature. No apparent electron energy reater than 62 MeV was observed in a $\mu-e$ spectrum involving ~ 5000 events. R.H.W.Johnston

539.12

617. ON $\pi \to e + \nu + \gamma$ DECAY. V.G.Vaks and B.L.Ioffe.
h. eksper. teor. Fiz., Vol. 35, No. 1(7), 221-7 (1958). In Russian.

The decay is investigated for vector and axial-vector interactions. An exact relation between the probability of $\pi \to e + \nu + \gamma$ ecay in vector theory and the probability of $\pi^0 \to 2\gamma$ decay can be established if one assumes that the direct interaction between -mesons and the electron—neutrino field suggested by Gell-Mann nd Feynman exists in the vector theory. It is ultimately found that n the total probability for $\pi \to e + \nu + \gamma$ decay the main role is layed by decay due to axial interaction, the ratio of the total robability for $\pi \to e + \nu + \gamma$ decay to the probability for $\pi \to \mu + \nu$ ecay being of the order of 5×10^{-6}. Expressions are obtained or the angular and energy distributions of the electrons and quanta.

539.12

618. ANGULAR DISTRIBUTION IN $\pi-\mu$ DECAY.
P.Connolly and G.Lynch.
uovo Cimento, Vol. 9, No. 6, 1077-81 (Sept. 16, 1958).

Analysis has been made of the decays of 5034 photoproduced π^+ mesons stopping in nuclear emulsion. The angular distribution is onsistent with isotropy.

539.12

2619. MUON ANGULAR DISTRIBUTION FROM PION DECAY IN EMULSIONS.
C.Castagnoli, M.Ferro-Luzzi and A.Manfredini.
Ricerca Sci., Vol. 28, No. 8, 1644-9 (Aug., 1958).

Measurements performed on 6978 mesons are discussed; the conclusion is that, if several instrumental effects are taken into account, any asymmetry is eliminated. The instrumental effects are discussed and the results compared with those obtained by other authors.

539.12

2620. ANGULAR CORRELATION FOR LOW-ENERGY POSITRONS EMITTED IN $\pi^+-\mu^+-e^+$ DECAY.
A.O.Vaĭsenberg, V.A.Smirnitskiĭ, É.D.Kolganova, É.V.Minervina, E.A.Pesotskaya and N.V.Rabin.
Zh. eksper. teor. Fiz., Vol. 35, No. 3(9), 645-8 (1958). In Russian.

The energies of 1099 positrons from $\pi^+-\mu^+-e$ decays in photographic emulsions and the angles θ between the direction of emission of the μ-meson and positrons were measured. It is shown that in the energy regions $\epsilon = (0.-0.3)$, $(0.3-0.6)$ and (> 0.9) the asymmetry coefficient or $\cos\theta$, which is proportional to it, are respectively equal to +0.18 ± 0.10, 0.00 ± 0.04 and −0.09 ± 0.04 (ϵ is the positron energy in units of maximal energy). 201 low-energy positrons ($\epsilon < 0.3$) were selected and measured from a total of 8000 $\pi^+-\mu^+-e^+$ decay events. For these positrons $\cos\theta =$ +0.07 ± 0.05. An estimate based on the χ^2-criterion shows that the probability of positive asymmetry in the 0-0.3 energy range is close to 95%.

539.12

2621. ON A POSSIBLE TEST OF SYMMETRY IN PION—BARYON INTERACTIONS. D.Amati and B.Vitale.
Nuovo Cimento, Vol. 9, No. 5, 895-901 (Sept. 1, 1958).

It is shown that the study of the branching ratios from absorption of low-energy K^- on protons (from the continuum) can give a good insight about the symmetries in strong interactions. The possibility of deriving the K—H relative parity from the analysis of high-energy absorption processes is also discussed.

539.12

2622. ON A COMPOUND MODEL OF THE PION—HYPERON INTERACTIONS. D.B.Lichtenberg and M.Ross.
Nuovo Cimento, Vol. 10, No. 1, 104-10 (Oct. 1, 1958).

The pion—hyperon interactions are considered in the light of a compound model in which a hyperon is taken to be a system of a nucleon plus a meson whose only role is to give the hyperon its observed symmetry properties. It is assumed that pions interact with the nucleon in a hyperon as if the nucleon were free, and that pions do not interact appreciably with the new meson. The pion interactions with the Λ and Σ which follow from this model are equivalent to the interactions of the elementary particle theory of Gell-Mann. The pion interactions with the Ξ are not unique without a further restriction on the model. As an example of this non-uniqueness, two different ΞN potentials are obtained, one of which is approximately the same as the ordinary nucleon—nucleon potential, while the other is much weaker at large distances.

539.12

2623. A NOTE ON THE APPARENT INCONSISTENCY AMONG MEASUREMENTS OF THRESHOLD PION INTERACTIONS.
M.Cini, R. Gatto, E.L.Goldwasser and M.Ruderman.
Nuovo Cimento, Vol. 10, No. 2, 243-58 (Oct. 16, 1958).

The apparent inconsistency among threshold pion interactions is resolved by the use of extrapolation procedures for charge exchange and photoproduction amplitudes more in accord with theory than conventional linear extrapolations.

539.12

2624. PARITY AND OTHER SYMMETRIES IN STRONG INTERACTIONS. A Pais.
Phys. Rev. Letters, Vol. 1, No. 11, 418-20 (Dec. 1, 1958).

Although no evidence for parity violation has been found in $\pi^- + p \to \Lambda + K^0$, there are certain models for the strong interactions (Pais, Abstr. 3704/1958) which suggest looking for parity violation in other reactions, such as $\pi^+ + p \to \Sigma^+ + K^+$. A further test suggested by Pais' model is to compare production rates of charged and neutral K mesons. J.C.Taylor

539.12

2625. INTERACTION OF 80-300 MeV π^+-MESONS WITH LIGHT NUCLEI. G.A.Blinov, M.F.Lomanov, Ya.Ya.Shalamov, V.A.Shebanov and V.A.Shchegolev.
Zh. eksper. teor. Fiz., Vol. 35, No. 4(10), 880-6 (1958). In Russian.

A 17 litre bubble chamber was used to study the interaction between π^+-mesons and nuclei. The scattering cross-sections for scattering, absorption, charge-exchange scattering and generation of charged mesons were measured. Processes of absorption and charge-exchange scattering are discussed.

539.12

2626. A PROPANE BUBBLE-CHAMBER STUDY OF THE INTERACTION BETWEEN 250-270 MeV π^+-MESONS AND CARBON NUCLEI.
Van Gan-Chan, Van Tsu-Tszen, Din Da-Tsao, L.N.Dubrovskiĭ, E.N.Kladnitskaya and M.I.Solov'ev.
Zh. eksper. teor. Fiz., Vol. 35, No. 4(10), 899-906 (1958). In Russian.

The interaction between 250-270 MeV π^+-mesons and carbon nuclei was studied with the help of a propane bubble chamber. The total and differential cross-sections for elastic and inelastic scattering of π^+-mesons as well as the total cross-section for absorption and charge-exchange of the π^+-mesons were determined. The prong distributions were obtained for stars containing mesons and for stars not containing mesons. Within the experimental error elastic scattering can be described by diffractional scattering for a nucleus with $k = 0.54 \times 10^{13}$ cm^{-1}, V = 30 MeV and R = 3.2×10^{-13} cm. The inelastic scattering data confirm the assumption that π-mesons interact with separate nucleons in the nucleus and that the number of interactions in the carbon nucleus is not large. Analysis of stars not containing mesons permit one to assert that the absorption of a π^+-meson in the carbon nucleus and the subsequent decay of the π^+—C system cannot be explained on basis of the evaporation model and the cascade process.

539.12

2627. APPLICATION OF THE TANGENT METHOD TO THE MEASUREMENT OF MULTIPLE SCATTERING OF π-MESONS STOPPED IN NUCLEAR EMULSION.
B.Dépaux and Tsai-Chü.
C.R. Acad. Sci. (Paris), Vol. 247, No. 12, 879-81 (Sept. 22, 1958). In French.

The "scattering constant" appropriate to the case where direct angular measurements are made (instead of coordinate differences) was determined with a standard error of about 7%.

R.H.W.Johnston

539.12

2628. THE KINEMATICS OF MESON INTERACTIONS WITHIN NUCLEI. K.M.Watson and C.Zemach.
Nuovo Cimento, Vol. 10, No. 3, 452-67 (Nov. 1, 1958).

The optical model of the nucleus, which has proved useful in the study of coherent scattering processes, is applied to the inelastic scattering of π-mesons by nuclei. Various aspects of meson and nucleon kinematics as modified by the presence of the optical model potential are discussed. Formulae and numerical results which relate free pion—nucleon cross-sections to cross-sections for pion—nucleon collisions within nuclei are also given. They indicate that the coherent effects described by the optical model play an important role in the inelastic scattering of mesons.

539.12

2629. THE RADIATIVE PION—NUCLEON SCATTERING IN STATIC THEORY. B.Bosco and R.Stroffolini.
Nuovo Cimento, Vol. 10, No. 4, 688-97 (Nov. 16, 1958).

Radiative pion—nucleon scattering is studied in static theory, treating one meson exactly, and the other one in the one-meson approximation. Explicit expressions for the re-scattering corrections are obtained.

539.12

2630. ELASTIC SCATTERING OF 300 MeV π-MESONS ON DEUTERONS. L.S.Dul'kova, I.B.Sokolova and M.G.Shafranova.
Zh. eksper. teor. Fiz., Vol. 35, No. 2(8), 313-15 (1958). In Russian.

The interaction of 300 ± 15 MeV π^+-mesons and 295 ± 10 MeV π^--mesons with deuterons was studied with the aid of photographic plates impregnated with deuterated lithium acetate. The cross-sections and angular distributions of π^+- and π^--mesons elastically scattered by deuterons were investigated.

539.12

2631. INELASTIC SCATTERING OF 300 MeV POSITIVE AND NEGATIVE π-MESONS ON PHOTOGRAPHIC EMULSION NUCLEI.
G.E.Belovitskiĭ.
Zh. eksper. teor. Fiz., Vol. 35, No. 4(10), 838-44 (1958). In Russian.

Results of measurement of the cross-sections for inelastic scattering and of the angular distributions and energy spectra of inelastically scattered π^+- and π^--mesons of 300 MeV energy on photographic emulsion nuclei are presented. Some other characteristics of inelastic scattering were also obtained.

539.12 : 539.17

2632. ABSORPTION CROSS SECTIONS OF CARBON, IRON AND LEAD FOR 1.5 GeV NEGATIVE PIONS AND 2.8 GeV PROTONS.
T.Bowen, M.Di Corato, W.H.Moore and G.Tagliaferri.
Nuovo Cimento, Vol. 9, No. 5, 908-19 (Sept. 1, 1958).

The cross-sections were measured with a multi-plate expansion cloud-chamber exposed to beams from the Brookhaven Cosmotron. The results are compared to an optical model computation assuming a nuclear potential distribution with the form of the charge density distribution indicated by electron scattering experiments. The measured cross-sections appear to agree with the ones deduced usin this model from the known values of the free pion—nucleon and proton—nucleon total cross-sections.

539.12

2633. PHENOMENOLOGICAL ANALYSIS OF THE PRODUCTION OF PION PAIRS. R.F.Peierls.
Phys. Rev., Vol. 111, No. 5, 1373-9 (Sept. 1, 1958).

The angular distribution for the production of pairs of pions by photons or pions incident on nucleons is analysed in terms of the various angular momentum states involved. A general expression is derived and then the effect of various assumptions about which states should be important is examined. It is found that an examination of the relative azimuth of the pions should give information about the nature of the process, and in particular about the existence of a resonant state of the nucleon, and its angular momentum.

539.12

2634. PION PRODUCTION IN HIGH-ENERGY PROCESSES.
S.N.Gupta.
Phys. Rev., Vol. 111, No. 6, 1698 (Sept. 15, 1958).

It is shown that the high-energy experiments on pion production favour, rather than rule out, the possibility of the existence of a new highly unstable neutral scalar meson (the ρ^0 meson).

539.12

2635. EXAMPLE OF THE PRODUCTION OF A π^- MESON BY A K^+ MESON. E.Helmy, J.H.Mulvey, D.J.Prowse and D.H.Stork.
Phys. Rev., Vol. 112, No. 5, 1793-5 (Dec. 1, 1958).

In 50 m of 200-300 MeV K^+-meson track followed in nuclear emulsion, one interaction event has been found from which a pion track emerges. The incoming K^+ meson had a kinetic energy of 323 ± 20 MeV. The K^+ meson re-emerged with an energy of 30 MeV at 36 degrees. The pion track has a characteristic negative-pion ending, and the pion was emitted with 34 MeV at 96 degrees. In addition a 40 MeV proton left the star at 81 degrees and there are three other short tracks. Although the kinematics admit an analysis in which no inelastic secondary process occurred among the primary reaction products, strong inelastic secondary processes are quite possible and must be considered. Charge independence holds important implications for the pion yield charge ratios and the early trend of negative excees seems rather striking.

539.12

2636. π^+ PRODUCTION IN Al AND C BY 209 MeV POLARIZED PROTONS. E.Heer, A.Roberts and J.Tinlot.
Phys. Rev., Vol. 111, No. 2, 640-4 (July 15, 1958).

The production of π^+-mesons by 209 MeV polarized protons incident on aluminium and carbon was studied at production angles of 92° (for both elements) and 120° and 144° (for Al alone). Normalized right—left asymmetries of the order of −0.5 are observed at 92° in both elements and for mesons in the range 26-51 MeV. The asymmetry appears to decrease rapidly with increasing production angle. The absolute production cross-sections are determined with statistical uncertainties of about 10%. The cross-sections at 92° are approximately proportional to the atomic weights of the two target materials, and the angular distribution in Al is almost isotropic for all meson energies.

539.12 : 539.17

2637. ENERGY SPECTRA AND ANGULAR DISTRIBUTION OF π^+-MESONS PRODUCED IN P—P COLLISIONS AT 600-670 MeV.
A.G.Meshkovskiĭ, Ya.Ya.Shalamov and V.A.Shebanov.
Zh. eksper. teor. Fiz., Vol. 35, No. 1(7), 64-70 (1958). In Russian.

The energy spectra of π^+-mesons produced in p—p collisions at proton energies of 670 MeV were investigated for observation angles of 19°30', 38°, and 56°. It was found that in the c.m.s. the shape of the π^+-meson spectrum for the $pp \rightarrow pn\pi^+$ reaction depends on the emission angle. The angular distribution of π^+-mesons produced in 660 MeV p—p collisions is given, in the c.m.s. The total cross-section was found to equal $(14.4 \pm 1.2) \times 10^{-27}$ cm^2.

539.12 : 539.17

2638. MEASUREMENT OF THE TOTAL CHARGED π-MESON PRODUCTION CROSS SECTION IN N—P COLLISIONS AT NEUTRON ENERGY 586 MeV.

Yu.M.Kazarinov and Yu.N.Simonov.

Zh. eksper. teor. Fiz., Vol. 35, No. 1(7), 78-84 (1958). In Russian.

The total yield of charged π-mesons produced in collisions between 586 MeV effective energy neutrons and protons was measured at angles between 15 and 120° (in the laboratory system). Assuming charge symmetry of nuclear forces the total cross-section for production of π^+ and π^--mesons derived on basis of the experimental data was found to be equal $\sigma(np \to \pi^+) = \sigma(np \to \pi^-) = (2.0 \pm 0.5) \times 10^{-27}$ cm^2.

539.12

2639. PHOTOPRODUCTION OF NEUTRAL PIONS AT ENERGIES 500 TO 940 MeV.

J.I.Vette.

Phys. Rev., Vol. 111, No. 2, 622-31 (July 15, 1958).

The process $\gamma + p \to \pi^0 + p$ was studied by detecting recoil protons from a liquid-hydrogen target which was bombarded by the bremsstrahlung beam of the California Institute of Technology electron synchrotron. The angle and momentum of the recoil protons were measured by a magnetic spectrometer-three scintillation counter coincidence system. The process has been studied between photon laboratory energies of 490 and 940 MeV and between pion centre-of-mass angles of 31.5° and 147°. Protons which arose from meson pair production were significant at forward laboratory angles. A correction for this contamination is discussed. The results of these measurements show two interesting features. One is that the total cross-section, which falls very rapidly above the $\frac{3}{2} - \frac{3}{2}$ resonance energy near 320 MeV, reaches a minimum at about 600 MeV and then increases to a broad maximum near 800 or 900 MeV. The other striking feature of the data is that the shape of the angular distribution seems to change rather suddenly near 900 MeV.

539.12 : 539.14

COHERENT NEUTRAL PION PRODUCTION. See Abstr. 1715

539.12

2640. ON THE POLARIZATION OF RECOIL NUCLEONS IN THE PHOTOPRODUCTION OF π-MESONS.

N.F.Nelipa and V.A.Feoktistov.

Zh. eksper. teor. Fiz., Vol. 35, No. 1(7), 244-8 (1958). In Russian.

A general expression for the polarization of recoil nucleons appearing during the production of π-mesons by photons was obtained on the basis of the laws of conservation of momentum and parity. As an example an expression is given for a polarization in a case of π-mesons production in s-, p- and d-states.

539.12

2641. PHOTOPRODUCTION OF SLOW π^0-MESONS ON COMPLEX NUCLEI.

A.S.Belousov, S.V.Rusakov and E.I.Tamm.

Zh. eksper. teor. Fiz., Vol. 35, No. 2(8), 355-63 (1958). In Russian.

Results of measurement of the dependence of the cross-section for photoproduction of slow π^0-mesons on the atomic number of the target nuclei are presented for nuclei between C and Pb. For peak synchrotron γ-ray energies of 265 and 210 MeV the cross-section is given by $\sigma \sim A^{2/3}$. The dependence of the yield of slow π-mesons on the maximal γ-ray energy was measured for carbon and lead. The results agree with the theory of production of π-mesons on the surface of the nucleus.

539.12

2642. FORMATION OF TWO π-PARTICLES IN COLLISIONS BETWEEN π-MESONS OR γ-QUANTA AND NUCLEONS OR DEUTERONS.

N.V.Dushin.

Zh. eksper. teor. Fiz., Vol. 35, No. 2(8), 401-7 (1958). In Russian.

The production of two π-particles in collisions between π-particles or γ-quanta and nucleons or deuterons is studied by a phenomenological method for small angles of emission of the produced π-particles.

539.12

2643. ON THE POSSIBILITY OF DETERMINING THE INTERACTION CONSTANTS FROM EXPERIMENTS ON $K_{\mu 3}$-DECAY.

I.G.Ivanter.

Zh. eksper. teor. Fiz., Vol. 35, No. 1(7), 111-15 (1958). In Russian.

Expressions for the spectra and polarization of μ-mesons created in $K_{\mu 3}$-decays were obtained for fixed π-meson energies and arbitrary complex interaction functions. It is shown that within an accuracy to an unimportant phase shift one can determine from measurements of the spectra and three polarizations all interaction functions excepting the second vector one which, under the conditions of the given experiments, cannot be separated from that of the first vector and scalar interaction functions. The presence of tensor interaction can be found from measurements on the spectrum and polarizations of μ-mesons near an energy close to the maximal value.

539.12

2644. INTERACTIONS AND DECAYS OF K^--MESONS. III. ANALYSIS OF THE STARS IN FLIGHT.

Y.Eisenberg, W.Koch, E.Lohrmann, M.Nikolić, M.Schneeberger and H.Winzeler.

Nuovo Cimento, Vol. 9, No. 5, 745-79 (Sept. 1, 1958).

For Pt II, see Abstr. 6177 (1958). 415 interactions of K^--mesons in flight with complex nuclei of nuclear emulsion have been analysed. Comparing the derived results with those obtained by Alvarez et al. from K^--free proton absorptions at rest, it must be concluded, that there is a significantly higher fraction of Λ-hyperons produced directly through the reaction $K^- + N \to \Lambda + \pi$, for these stars in flight (average kinetic energy of the interacting K-mesons 86 MeV), than must be expected if one transfers the Alvarez results to compound nuclei assuming isotopic spin conservation. If the fraction of directly produced Λs increases with increasing K^--energy, one could expect also a real increase in the direct Λ-production in the K^--absorptions "at rest" in the nuclear emulsion, because of the Fermi-motion of the nucleons. Other topics which are discussed are the energy spectrum and absorption probabilities of the pions and Σ-hyperons and also the relative number of hyperfragments observed per Λ-hyperon produced.

539.12

2645. INTERACTION OF NEGATIVE K MESONS WITH PROTONS.

G.Ascoli, R.D.Hill and T.S.Yoon.

Nuovo Cimento, Vol. 9, No. 5, 813-21 (Sept. 1, 1958).

Ten events of elastic and four events of inelastic scattering of K^--particles by free protons in nuclear emulsions were observed in the K-particle energy range from 5 to 70 MeV. These data when added to those from other laboratories are consistent with an s-wave interaction between the negative K-particle and proton at low K-particle energies. A preliminary investigation of the evidence for isotopic spin states 0 and 1 is also made.

539.12

2646. NUCLEAR INTERACTIONS OF NEUTRAL K-MESONS OF LONG LIFETIME.

V.Bisi, R.Cester, A.Debenedetti, C.M.Garelli, B.Quassiati, L.Tallone and M.Vigone.

Nuovo Cimento, Vol. 9, No. 5, 864-79 (Sept. 1, 1958).

An emulsion stack was exposed at the Berkely Bevatron, to a neutral beam emitted at 45° with the internal beam entering a Be target. The total distance between stack and target was 6 m. 9 K^+, 8 particles of strangeness — 1, and 4 hyperfragments, all from stars in emulsion, were found scanning for interaction products of long lived neutral K. From the relative frequency of particles with different strangeness the composition of the θ_2^0 beam entering the stack is deduced. The experimental result is compatible with a strangeness mixture of the type proposed by Gell-Mann and Pais.

539.12

2647. K^- INTERACTIONS WITH FREE PROTONS IN NUCLEAR EMULSION.

R.G.Glasser, N.Seeman and G.A.Snow.

Nuovo Cimento, Vol. 9, No. 6, 1085-90 (Sept. 16, 1958).

A total of 19 (K^-,p) elastic scattering events and fourteen $K^- + p \to \Sigma^\pm + \pi^\mp$ events in flight were found, including the results reported previously. Averaging over the energy region (0-82) MeV, the cross-sections are respectively, $\sigma_e = (37^{+9}_{-9})$ mb and $\sigma_a = (27^{+8}_{-6})$ mb. The best estimate of the Σ^+/Σ^- ratio at production is $1.2^{+1.0}_{-0.6}$.

539.12 : 539.17

2648. ANALYSIS OF INELASTIC INTERACTIONS OF K^+-MESONS WITH EMULSION NUCLEI (40-150 MeV).

M.Grilli, L.Guerriero, M.Merlin and G.A.Salandin.

Nuovo Cimento, Vol. 10, No. 2, 205-27 (Oct. 16, 1958).

212.5 m of K^+ track were followed in an unbiassed way in the energy interval from 40 to 150 MeV. The events found are classified as follows: (1) 8 K—H interactions; (2) 184 inelastic scatterings (excluding the charge exchange); (3) 23 charge exchange. All these events have been divided into four energy intervals. In the present work, data on the K^+—nucleus and K^+—nucleon inelastic interactions are given. For the K^+—nucleus interactions the following are given: (i) the variation of the total cross-section with the primary energy; (ii) the angular and energy loss distributions and their correlation;

(iii) further support for a nuclear repulsive potential. Starting from the inelastic events, an analysis is made to find the elementary K—nucleon cross-sections. The peculiar feature of the analysis consists in taking into account the correlation between the angular and energy loss distributions. Using a maximum likelihood method the angular distribution in the centre of mass system is chosen which reproduces the observed distributions for inelastic events. Particular care is taken to ensure that the separation between elastic and inelastic events does not alter the essential results of the analysis. Tests on the internal consistence of the analysis have also been made. The total and angular K—free nucleon and K—free neutron cross-sections (for scattering as well as for charge exchange) are deduced with this analysis. The values for elementary cross-sections are compared with those estimated by other authors. Finally, the scattering amplitudes and the relative weight of the T = 1 and T = 0 states are evaluated.

539.12

2649. PHENOMENOLOGICAL DISCUSSION OF THE SCATTERING AND ABSORPTION OF K-MESONS BY PROTONS.

J.D.Jackson, D.G.Ravenhall and H.W.Wyld, Jr.
Nuovo Cimento, Vol. 9, No. 5, 834-41 (Sept. 1, 1958).

An effective range expansion is used to describe the complex phase-shifts; s-wave interactions are assumed dominant: only the crudest approximation, that of zero effective range, is illustrated. The scattering and absorption of K^--mesons by protons and the scattering of K^+-mesons by protons are consistent with this zero range approximation. The appreciable fall-off of the K^- elastic scattering cross-section with increasing energy as compared to the essential constancy of the K^+ cross-section is attributable in large part to the presence of the absorption in flight for K^- mesons. The connection between the cross-sections for absorption in flight from states of definite angular momentum and the capture rates from the corresponding bound states is explicitly stated and the possibility of correlating the data from the two sources is discussed.

539.12

2650. K^+ MESON—NUCLEON SCATTERING PHASE SHIFT ANALYSIS.

O.R.Price, D.H.Stork and H.K.Ticho.
Phys. Rev. Letters, Vol. 1, No. 6, 212-14 (Sept. 15, 1958).

A χ^2 best fit of the four phase-shifts δ_{10}, δ_{00}, δ_{01} and δ_{03} was performed making use of world data for 125 MeV K^+ meson scattering in emulsion. The diffuse-surface optical model was used to obtain a complex potential $V + iW$, where $V = 23 \pm 4$ MeV and $W = 9.7 \pm 1.3$ MeV for a Saxon potential with $R = 1.07\,A^{1/3}$ f, $a = 0.57$ f. δ_{10} was obtained from the world free hydrogen data: $\delta_{10} = -20.2 \pm 1.2^0$. Two good-fit solutions for the other three quantities were found. These could be made to coalesce by changing the radius parameter of the Saxon potential to $R = 1.20\,A^{1/3}$ f, giving values $\delta_{00} = -3^0$, $\delta_{01} = +9^0$ and $\delta_{03} = +9^0$.

R.H.W.Johnston

539.12 : 539.17

2651. EMISSION OF CHARGED $\Sigma + \pi$ FROM K^-—PROTON CAPTURE IN NUCLEAR EMULSIONS.

S.Nilsson and Å.Frisk.
Ark. Fys., Vol. 14, Paper 20, 303-14 (1958).

A 100 two-prong stars with charged baryon and π-meson only from K^--capture in nuclear emulsions were analysed. 23 $\Sigma^+ + \pi^-$, 30 $\Sigma^- + \pi^+$ and 9 $\Sigma^\mp + \pi^\pm$ events were compatible with captures on bound and free protons. A comparison between the experimental and expected hyperon energy distribution, using a degenerate Fermi gas model of the nucleus, gives a best fit for an attractive real Σ-nuclear potential of 25 MeV. An average Coulomb potential of the capturing nucleus of 8 ± 2 MeV is deduced. The fraction of zero-prong Σ^--stars is 0.66 ± 0.10. The Σ^--mass is found to be $m = 1196.7 \pm 0.6$ MeV from three K^--captures on free protons.

539.12

2652. YIELDS OF K^+ AND K^- MESONS PRODUCED BY 1.7 TO 3 BeV PROTONS.

J.Hornbostel, E.O.Salant and G.T.Zorn.
Phys. Rev., Vol. 112, No. 4, 1311-18 (Nov. 15, 1958).

Nuclear emulsions were used to measure yields of K^+ and K^- mesons produced in Be (and Pb) nuclei by Cosmotron protons of various energies, ranging from 1.7 to 2.95 BeV. The experimental equipment accepted particles emitted in the forward direction with momenta of about 300 MeV/c. At 2.95 BeV, the K^+ yield from Be corresponds to a differential cross-section per nucleus of $(4.0 \pm 0.5) \times 10^{-31}\ \mathrm{cm}^2\ (\mathrm{MeV/c})^{-1}\ \mathrm{sterad}^{-1}$; the K^- cross-section is 26 times smaller. The K^+ cross-section of Pb is larger than that of Be by a factor approximately equal to the ratio of the geometric cross-sections of these nuclei. With decreasing proton energy, the K^- yield falls more rapidly than the K^+ yield. The energy dependence of the yields was compared with curves which were computed, on the assumption of constant matrix elements, fr the phase-space factors of production reactions required by the principle of conservation of strangeness. For K^-, the results of th these calculations agree with the experimental data; for K^+, the yield falls more rapidly with decreasing primary energy than expected from the computations.

539.1

2653. NEUTRAL DECAY MODES OF THE θ_1^0 AND Λ^0.

E.Boldt, H.S.Bridge, D.O.Caldwell and Y.Pal.
Phys. Rev., Vol. 112, No. 5, 1746-9 (Dec. 1, 1958).

In a large multiplate cloud chamber, an event has been found which strongly indicates that the decay mode $\theta_1^0 \rightarrow 2\pi^0$ exists, and therefore that the spin of the K meson is even. Two showers are seen which, from their spatial angles and energies, must represent essentially the whole energy of the two π^0's from a θ_1^0 produced in association with a Λ^0. On the basis of this event, the fraction of θ_1^0 decays going by the $2\pi^0$ mode is ~0.06, and the probability that this fraction could be consistent with the value of $\frac{1}{3}$ predicted by $\Delta I = \frac{1}{2}$ selection rule is 3%. Furthermore, the chance that the observed ratio is $\geq \frac{1}{4}$, a value possible with an admixture of $\Delta I = \frac{3}{2}$, is 10%. The observation of single shower events attributabl to $\theta_1^0 \rightarrow 2\pi^0$ give even smaller probabilities that the fraction of neutral decays is as large as $\frac{1}{3}$ or $\frac{1}{4}$, but the necessity of a background subtraction makes these results less significant. On the other hand, the fraction of Λ^0 decays going by a neutral decay mode is quite consistent with the value of $\frac{1}{3}$ predicted by the $\Delta I = \frac{1}{2}$ rule. The values obtained for this fraction are 0.22 ± 0.13 from the direct observation of showers (presumably from $\Lambda^0 \rightarrow n + \pi^0$), and 0.33 ± 0.06 from the number of Λ^0's not decaying by the charged mode.

539.12

2654. DECAY MODES OF A $(\theta + \bar{\theta})$ SYSTEM.

M.Goldhaber, T.D.Lee and C.N.Yang.
Phys. Rev., Vol. 112, No. 5, 1796-8 (Dec. 1, 1958).

Relations among the different states of a system consisting of a θ meson, a $\bar{\theta}$ meson, and a certain number of pions are discussed. Theorems concerning certain correlations between the production probabilities for charged and uncharged θ mesons and the decay modes (θ_1^0 and θ_2^0) are obtained.

539.12

2655. THE SELECTION RULES ON THE HYPERON DECAYS.

K.Nakagawa and H.Umezawa.
Nuovo Cimento, Vol. 8, No. 6, 945-8 (June 16, 1958).

Experimental data on $\Sigma \rightarrow N + \pi$ decay modes are discussed in terms of a (V,A)-type direct interaction. It appears that the i-spin selection rule $\Delta I = \pm\frac{1}{2}$ may not hold. R.J.N.Phillips

539.12

2656. PHOTON DECAY OF HYPERONS.

R.E.Behrends.
Phys. Rev., Vol. 111, No. 6, 1691-7 (Sept. 15, 1958).

The photon mode of decay of the Σ^+ and Λ^0 is examined. The lifetime and angular distributions of the decay products are written in terms of the three physical parameters of the problem without restriction as to invariance under space reflection, charge conjugation, or time reversal. An estimate of these parameters is made by use of perturbation theory, and, although ambiguous, it indicates that this mode may soon be experimentally detectable.

539.12 : 539.14

2657. PARITY NONCONSERVATION IN THE DECAY OF FREE AND BOUND Λ PARTICLES.

R.H.Dalitz.
Phys. Rev., Vol. 112, No. 2, 605-13 (Oct. 15, 1958).

A quantitative estimate is made of the branching ratio between two-body and more complicated mesonic decay modes for ${}_{\Lambda}He^4$ and ${}_{\Lambda}H^4$, as function of their spin J and the ratio p/s of the s- and p-channel amplitudes in free Λ decay. Comparison with the data on ${}_{\Lambda}H^4$ decay indicates that J = 1 is rather improbable and that, with J = 0, an upper limit on p/s is about unity, a lower limit of 0.45 bein obtained from the observations on up-down asymmetry in polarized Λ decay. The theoretical and experimental values for the non-mesonic/mesonic ratio in hypernuclear decay are compared in the light of these limits on p/s. Assuming validity of the $\Delta T = \frac{1}{2}$ rule, the variations in the π^-/π^0 ratio for decays of light hypernuclei ($Z \leq 2$) due to the effect of the Pauli principle are also estimated. A brief discussion of ${}_{\Lambda}H^3$ decay is given.

539.12

2658. LEPTONIC DECAY MODES OF THE HYPERONS.

F.Eisler, R.Plano, A.Prodell, N.Samios, M.Schwartz, J.Steinberger, M.Conversi, P.Franzini, I.Manelli, R.Santangelo and V.Silvestrini.
Phys. Rev., Vol. 112, No. 3, 979-81 (Nov. 1, 1958).

A search was made for the leptonic decay of the Λ^0 and Σ^-. The sensitivity of the experiment was such that 5-6 events should have been found according to the predictions of the "universal" V–A model of β-decay. No examples of leptonic decay were observed.

539.12

2659. LEPTONIC DECAYS OF HYPERONS.

P.Nordin, J.Orear, L.Reed, A.H.Rosenfeld, F.T.Solmitz, H.D.Taft and R.D.Tripp.
Phys. Rev. Letters, Vol. 1, No. 10, 380-2 (Nov. 15, 1958).

An example is described of the electronic decay of a Λ^0 produced by capture in hydrogen of a K^--meson. This event was detected by its obviously anomalous features during a systematic examination of 7000 cases of hyperon production, about 2000 of them Λ^0's. An attempt is made to summarize the results of all experiments in which hyperons were examined in sufficient detail to detect leptonic decay, estimates being made of the expected losses due to the similarity of some of these decays to normal decays, and of the number which would appear anomalous on inspection and therefore be detected without detailed measurements. The results are tabulated, showing three examples of electronic decay and no examples of muonic decay in some 2000 "effective" hyperon decays. This is much less than the 41 which would be expected on the basis of the Feynman–Gell-Mann theory.

S.J.Goldsack

539.12

2660. BETA DECAY OF THE Λ.

F.S.Crawford,Jr, M.Cresti, M.L.Good, G.R.Kalbfleisch, M.L.Stevenson and H.K.Ticho.
Phys. Rev. Letters, Vol. 1, No. 10, 377-80 (Nov. 15, 1958).

A negative π-meson from a 1.23 BeV/c beam interacted with a proton in a hydrogen bubble chamber, apparently producing a Λ^0 meson. The decay of the latter is shown to be anomalous, and the products to be respectively, a proton and a particle lighter than a π-meson, with about 30 : 1 odds in favour of an electron rather than a μ-meson. When the kinematics of the decay are considered, the odds are still more heavily weighted towards the electron. This event has been detected amongst 689 observed decays: allowing for the neutral decays of Λ's and for the change of a leptonic decay escaping detection, it is estimated that the equivalent number should be increased to 1042. The form of the universal β-decay interaction proposed by Feynman and Gell-Mann predicts 16×10^{-3} and 3×10^{-3} for electrons and muonic decay probabilities for the Λ.

S.J.Goldsack

539.12

2661. ON β-DECAY OF HYPERONS.

V.M.Shekhter.
Zh. eksper. teor. Fiz., Vol. 35, No. 2(8), 458-66 (1958). In Russian.

The probabilities of decay of hyperons into nucleons (hyperons) and leptons are computed. The energy distribution, correlations, polarization and asymmetry of emission of the particles are determined. Numerical calculations are made for the case of a universal V–A interaction. The probabilities of lepton decays of Σ^- and Λ^0-hyperons are found to considerably exceed the corresponding upper experimental limits.

539.12

2662. LIFETIME OF Λ⁰ θ⁰, AND Σ⁻.

F.Eisler, R.Plano, A.Prodell, N.Samios, M.Schwartz, J.Steinberger, P.Bassi, V.Borelli, G.Puppi, H.Tanaka, P.Waloschek, V.Zoboli, M.Conversi, P.Franzini, I.Mannelli, R.Santangelo and V.Silvestrini.
Nuovo Cimento, Vol. 10, No. 1, 150-4 (Oct. 1, 1958).

The lifetimes of the Λ^0, θ^0, and Σ^- observed in bubble chamber photographs have been calculated. The following values are obtained: $\tau_{\Lambda^0} = (2.29^{+.15}_{-.13}) \times 10^{-10}$ sec on the basis of 454 events; $\tau_{\theta^0} = (1.06^{+.08}_{-.06}) \times 10^{-10}$ sec on the basis of 259 events and $\tau_{\Sigma^0} = (1.89^{+.33}_{-.25}) \times 10^{-10}$ sec on the basis of 107 events. A comparison with previous values of the mean lives is presented.

539.12

2663. THE Λ-HYPERON–NUCLEON PROBLEM FROM MESON THEORY.

F.Ferrari and L.Fonda.
Nuovo Cimento, Vol. 9, No. 5, 842-63 (Sept. 1, 1958).

A discussion of the implications of meson theory with regard to the binding of the Λ-hyperon in nuclear matter is carried out taking explicitly into account the phenomenological results of Dalitz and Downs. The interactions through pions and K-mesons are analysed, considering all possible combinations of the parity of the Σ-hyperon and the K-meson. Particular attention is devoted to the case of a universal pion–baryon interaction. In this case one is led to the conclusion that the K-meson is pseudoscalar. Another solution to the problem can be obtained assuming that the Σ-hyperon has different parity from that of the Λ-hyperon. This implies that the K-meson contribution to the Λ-nucleon potential is of the same order of magnitude as that of the pion field. It is argued that no other solutions can be given. In particular the interaction through the K-meson field only is not able to give agreement with the experiment. The stability of the (Ξ, nucleon) and (Σ, nucleon) systems is also briefly discussed.

539.12

2664. ON THE Λ-HYPERON CREATION CROSS-SECTION NEAR THE Σ-HYPERON CREATION THRESHOLD.

A.I.Baz' and L.B.Okun'.
Zh. eksper. teor. Fiz., Vol. 35, No. 3(9), 757-61 (1958). In Russian.

A peculiarity exists in the cross-section of the $\pi^- + p \to K^0 + \Lambda^0$ reaction near the threshold of the reaction $\pi^- + p \to K_0 + \Sigma^0$. An experimental study of this peculiarity permits one to verify the validity of various model concepts regarding the interaction between strange particles, and also to determine the relative parity of Λ- and Σ-hyperons.

539.12

2665. Σ⁰ MASS.

M.L.Stevenson.
Phys. Rev., Vol. 111, No. 6, 1707-9 (Sept. 15, 1958).

The mass of the Σ^0 hyperon is obtained from a single associated production event in which both strange particles are observed to decay. The event is unusual, first because the Σ^0 hyperon decays directly into an electron–positron pair plus a Λ, and secondly because all the tracks are long and of higher-than-average quality. The value of Q_Σ obtained from this event is 76.4 ± 3.3 MeV, where $Q_\Sigma \equiv M_{\Sigma^0} - M_\Lambda$. For $M_\Lambda = 1115.2 \pm 0.14$ MeV, the mass of the Σ^0 is 1191.6 ± 3.3 MeV. Upon averaging this value with the existing measurements of Alvarez et al. and Eisler et al., one obtains $Q_\Sigma = 75.3_{-1.4}{}^{+0.9}$MeV, and hence $M_{\Sigma^0} = 1190.5_{-1.4}{}^{+0.9}$MeV.

539.12

2666. ON THE POSSIBLE EXISTENCE OF THE Ξ⁰-HYPERON.

É.O.Okonov.
Zh. eksper. teor. Fiz., Vol. 35, No. 5(11), 1232-4 (1958). In Russian.

It is suggested that the existence of a Ξ-hyperon may be the cause of the appreciable difference between the experimental values for the mean lifetimes of Λ^0-particles observed in cosmic rays and in accelerators. The lifetime and relative probability for Ξ-hyperon production are roughly estimated on basis of this assumption.

539.12

2667. BUBBLE CHAMBER STUDY OF UNSTABLE PARTICLE PRODUCTION IN π⁻–p COLLISIONS AT 910, 960, 1200 AND 1300 MeV.

F.Eisler, R.Plano, A.Prodell, N.Samios, M.Schwartz, J.Steinberger, P.Bassi, V.Borelli, G.Puppi, H.Tanaka, P.Waloschek, V.Zoboli, M.Conversi, P.Franzini, I.Mannelli, R.Santangelo and V.Silvestrini.
Nuovo Cimento, Vol. 10, No. 3, 468-89 (Nov. 1, 1958).

Results are reported on the total and differential cross-sections for the reactions $\pi^- + p \to \begin{array}{l} \Lambda^\circ + \theta^\circ \\ \Sigma^\circ + \theta^\circ \\ \Sigma^- + K^+ \end{array}$ at 910, 960, 1200 and 1300 MeV using hydrogen and propane bubble-chambers in a magnetic field of 13.4 kG. The chambers and their operation, as well as the method of analysis are described in detail.

539.12

2668. A DECAY OF AN ANTI-HYPERON, Λ̄⁰, IN NUCLEAR EMULSION.

D.J.Prowse and M.Baldo Ceolin.
Nuovo Cimento, Vol. 10, No. 4, 635-45 (Nov. 16, 1958).

An event which was found in a stack of nuclear emulsion exposed to 10^6 4.6 GeV π^--mesons per cm^2, is interpreted as an example of the decay in flight of an antihyperon, Λ^0. The event and the interpretation are discussed in detail.

539.12

2669. GLOBAL AND RESTRICTED SYMMETRY TESTS IN ANTIHYPERON PRODUCTION.

B.d'Espagnat and J.Prentki.
Nuclear Phys., Vol. 9, No. 2, 326-8 (Dec. [1], 1958).

The conditions of "global" and "restricted" symmetry of meson–hyperon interactions are stated and their consequences for hyperon pair creation briefly discussed.

539.12

2670. ANGULAR DISTRIBUTIONS IN STRANGE PARTICLES TWO BODY-DECAYS. M.Jacob.
Nuovo Cimento, Vol. 9, No. 5, 826-33 (Sept. 1, 1958).

General considerations are developed for the decay of a particle into two particles of arbitrary spins and some formulae are derived. The formalism introduced suits easily parity nonconserving decays. The results obtained are applied to $K_{\mu 2}$ decay and a numerical calculation is carried out in the special case of spin 2; the polarization of the emitted μ-meson is also discussed.

539.12

2671. DETAILED STUDIES OF AN EVENT INVOLVING THE MULTIPLE PRODUCTION OF STRANGE PARTICLES. Tsai-Chü.
Nuovo Cimento, Vol. 10, No. 3, 435-51 (Nov. 1, 1958).

Three strange particles emitted from a cosmic-ray star of the type 14 + 5p were found in the Sardinia stack S36. They are: (1) a negative hyperon captured at rest; (2) a positive hyperon decaying in flight; and (3) a negative K-meson interacting in flight. Detailed measurements of each particle are given. The three strange particles are coplanar. Each has the same strangeness number. Evidently, there are three pairs of strange particles emitted in this interaction. But, if the negative hyperon were an anti-hyperon, then two pairs should be emitted. It seems very probable that the strange particles are produced through a multiple rather than a plural process. In conclusion, this paper gives a rough estimate of the frequency ratio between multiple production events and all associated events involving two or more identified strange particles. The ratio is of the order 0.02 to 0.07 for two-nucleon interactions in the energy range of about 15 GeV.

539.12

2672. PRODUCTION OF STRANGE PARTICLES BY π–NUCLEON AND PHOTONUCLEON INTERACTIONS NEAR THRESHOLD.
R.K.Adair.
Phys. Rev., Vol. 111, No. 2, 632-9 (July 15, 1958).

An investigation of the behaviour of the π–nucleon reaction cross-sections near the strange particle threshold shows that the variation with energy of the Λ^0–K cross-section near the Σ–K threshold depends strongly upon the relative parities of the Σ and the Λ^0 hyperons. If the elements of the Wigner R-matrix are nearly stationary near the Σ–K threshold, and if the decay of the compound system is nearly independent of its mode of formation, the variation of the Λ^0 and Σ cross-sections is almost uniquely established from cross-sections measured at one energy. In particular, the Λ^0 cross-section exhibits strong cusps at the Σ–K thresholds. Angular distributions and polarizations are discussed from the viewpoint of these assumptions. The photonucleon production of strange particles is shown to be closely related to the π-nucleon production, essentially because the same final-state interactions are important. The strength and characteristics of these interactions lead to the conclusion that the matrix elements for photonucleon production of strange particles will, in general, be strongly affected in magnitude by the final-state interactions and they will not be real, even at threshold. The analysis of cusps, which are predicted in the $\gamma + p \rightarrow \pi +$ nucleon cross-section at the $\Lambda^0 +$ K threshold and the $\Sigma +$ K threshold, and in the $\gamma + p \rightarrow \Lambda^0 +$ K reaction at the $\Sigma +$ K threshold, should provide a means of determining the relative parities of the strange particles, in a manner almost independent of the dynamics of the reaction.

539.12

2673. DOUBLE ELASTIC SCATTERING OF DEUTERONS IN A MAGNETIC FIELD. G.R.Khutsishvili and O.D.Cheishvili.
Zh. eksper. teor. Fiz., Vol. 35, No. 5(11), 1226-31 (1958). In Russian.

Double elastic scattering of deuterons on nuclei in a magnetic field is considered. An expression for the angular distribution of deuterons was obtained. Particular cases of transverse and longitudinal fields are examined.

NUCLEUS

539.14

2674. THE NUCLEON EFFECTIVE MASS AND THE STATISTICAL MODEL OF THE NUCLEUS. E.Clementel and C.Villi.
Nuovo Cimento, Vol. 9, No. 6, 950-89 (Sept. 16, 1958).

The statistical model of the nucleus is refined taking into account the momentum dependence of the real part of the nucleon—nucleus potential. The promising features of this model are discussed with special regard to the concept of the nucleon effective mass. The determination of the nucleon effective mass is carried out taking into account separately the experimental value of the symmetry energy and of the nuclear level density observed in slow neutron capture experiments.

539.14 : 539.2

2675. THE QUANTUM-MECHANICAL MANY-BODY PROBLEM IN ATOMIC NUCLEI AND IN ELECTRON GASES. W.Macke.
Ann. Phys. (Leipzig), Vol. 20, No. 1-6, 80-92 (1957). In German.

The Brueckner—Bethe theory is reconsidered by means of a perturbation theory in all orders. Certain elements of the scattering matrix are simplified. By correcting the energy denominators, the unwanted 1/A terms of the energy expression can be made to disappear. This, in turn, makes a unique treatment of the interactio in higher approximations possible; these higher orders contain then only contributions from multiple scattering. P.Roman

539.14

2676. ON THE MOMENTUM DEPENDENCE OF THE NUCLEAR POTENTIAL. C.Villi.
Nuovo Cimento, Vol. 10, No. 2, 259-91 (Oct. 16, 1958).

It is shown that the potential energy of a nucleon in the nucleus, evaluated in the first approximation of the perturbation method or on the basis of Brueckner's theory, obeys a hyperbolic partial differential equation, which is independent of any nuclear parameter and is established by the antisymmetry properties of the nucleon assembly only. This nuclear equation rules the dependence of the potential both on the nucleon momentum and the nuclear density. The particular choice of the two-body forces or of the nucleon—nucleon phase-shifts for the evaluation of the potential energy of the nucleus, implies a specialization of the Cauchy problem, related to this equation, regardless of the saturation prescriptions of nuclear forces. It is shown that there exists a class of solutions of this nuclear equation which cannot be derived, in the first approximation of the perturbation method, from any of the known two-body potentials. This class of solutions, however, leads to the saturation of the nuclear binding energy and density as well as to the experimental value of the symmetry energy and to the correct behaviour, in the low energy region, of the real and imaginary parts of the nuclear potential. A mathematical proof is given of the dependence of the potential inside the Fermi sphere on even powers of the nucleon momentum, as required by the invariance prescription of the potential with respect to time reflection. The linear dependence of the potential on the square of the nucleon momentum, and the so-called nucleon effective mass approximation, is discussed in the light of the correspondence principle, which has been used to describe the motion of a nucleon in nuclear matter. Finally, it is shown that the Johnson—Teller, Schiff—Thirring and Drell—Huang theories of nuclear saturation implicitly involve only particular solutions of the considered nuclear equation.

539.14

2677. TWO-PARTICLE INTERACTIONS IN DEFORMED NUCLEI. T.Tamura.
Phys. Rev., Vol. 111, No. 3, 859-76 (Aug. 1, 1958).

Effects of two-particle interactions in deformed nuclei are considered. The deformed nucleus is assumed to be replaced by a set of particles in a cylindrically symmetric harmonic oscillator potential, while the two-particle interaction is assumed to be of δ-function type. Fairly extensive calculations are performed in diagonalizing the interaction energies which exist between particles lying in degenerate levels in the above-mentioned potential. The characteristic energies and the explicit form of the eigenfunctions are tabulated. In particular it is noticed that the seniority number is a good quantum number for this sort of interaction. Several important features of the results are discussed, including the matrix elements of the E2 transitions.

539.14

2678. COUPLING OF ANGULAR MOMENTA IN ODD—ODD NUCLEI. C.J.Gallagher,Jr and S.A.Moszkowski.
Phys. Rev., Vol. 111, No. 5, 1282-90 (Sept. 1, 1958).

The coupling of the angular momenta of individual particle states in odd—odd nuclei is shown to be generally describable as spin—spin coupling if the asymptotic-quantum-number description of particle states is used for deformed nuclei. Coupling rules for these nuclei are given, and all available data are treated by them. The results are compared with results based upon a j—j coupling model for a spherical nucleus. A formula based upon the present coupling description is given for calculating magnetic moments of deformed nuclei, and magnetic moments calculated by it are compared to the experimental moments and to those calculated assuming the gyromagnetic ratios of the odd nucleons are those given by the Schmidt formulae. A qualitative theoretical discussion of the basic validity of the coupling rules is given.

539.14

2679. RANGE OF SPIN—ORBIT FORCE BETWEEN TWO PROTONS. P.S.Signell, R.Zinn and R.E.Marshak.
Phys. Rev. Letters, Vol. 1, No. 11, 416-18 (Dec. 1, 1958).

It is shown that the spin—orbit force of the Signell—Marshak potential (Abstr. 7172/1957, 2468/1958) is not uniquely determined. A reduction in range to the "meson-theoretic" value does not harm the agreement with p—p scattering at 150 MeV, and gives a considerable improvement at 300 MeV. It is also shown that short-range repulsive cores may be introduced to eliminate the unphysical $^3P_2$ bound state without adverse effect on the scattering.

G.P.McCauley

539.14

2680. ON A THEOREM CONCERNING THE SINGLE PARTICLE ENERGY OF A FERMI GAS WITH INTERACTIONS. C.Villi.
Nuclear Phys., Vol. 9, No. 2, 306-13 (Dec. [1], 1958).

It is shown that the Hugenholtz and Van Hove theorem (see Abstr. 4263/1958) is a consequence of another theorem, which involves the existence of a hyperbolic partial differential equation, obeyed by the potential energy of a nucleon in an infinite sea of nuclear matter. The fundamental role played by this nuclear equation in describing the nucleus as a Fermi gas with interactions is discussed.

539.14

2681. NOTE ON THE SINGLE-PARTICLE ENERGY AND THE BINDING ENERGY OF MANY-BODY, SATURATED SYSTEMS.
G.A.Baker,Jr.
Canad. J. Phys., Vol. 36, No. 10, 1261-4 (Oct., 1958).

Brueckner has pointed out (Abstr. 5262/1958) that, for saturation, $(E_{av}\text{-}E(p_F))$ does not vanish in general because of "important many-body contributions to the single particle energy which arise from the effects of the exclusion principle and from the variation of the self-consistent excitation spectrum with density". It is the purpose of this note to evaluate this difference in terms of the properties of the single-particle potential.

539.14

2682. DYNAMICS OF AN ELASTIC ELLIPSOID.
R.K.Osborn and E.D.Klema.
Nuovo Cimento, Vol. 9, No. 5, 791-812 (Sept. 1, 1958).

This is an attempt to provide a dynamical basis for the kinematical scheme employed previously for the empirical correlation of certain nuclear data (Abstr. 4211/1958). The primary purpose of this paper is the delineation of the dynamical system itself. Particular attention is paid to the following points: (1) The basic assumptions required for the specification of the system. These may be divided roughly into two groups, those employed in the definition of the independent degrees of freedom chosen for the description of the system and those required for at least partial characterization of relevant potentials. The former are of principal importance in the formulation of the kinetic energy operators appropriate to the choice of degrees of freedom and are dealt with in detail. The latter, being less germane to the purpose of this paper, are treated more or less summarily. (2) The detailed development of the kinetic energy of this model. It is carried out without approximation; i.e. the formulation of this aspect of the physical implications of the model is quite rigorous. Calculations within the model must ultimately, of course, require resort to approximation. (3) The physical significance of two different representations employable for partial diagonalization of the Hamiltonian. (4) The close kinematical connection between the system considered and the hydrodynamical model. (5) The extent to which the dynamical system incorporates the kinematical scheme previously used for data correlation. Directions of feasible, and perhaps fruitful, generalization are indicated with the suggestion of possibly significant implications for the description of nuclear collective behaviour in regions in which neither purely vibrational nor purely rotational characteristics are to be expected.

539.14

2683. SINGLE-PARTICLE RADIATIVE PROCESSES IN THE OPTICAL MODEL OF THE NUCLEUS. F.Beck.
Nuclear Phys., Vol. 9, No. 1, 140-62 (Nov. [3], 1958). In German.

Using the "distorted wave approximation" and employing for the nuclear interaction a complex square well potential, the single particle contribution to the radiative capture of neutrons incident on a medium weight nucleus is calculated. Numerical results are obtained for the upper end of the γ-spectrum, $d\sigma(n,\gamma)/dE_\gamma$, for an incident energy of 20 MeV, and for the integrated cross-section, $\sigma(n,\gamma)(E_n)$, in the energy region $10\text{ MeV} \le E_n \le 20\text{ MeV}$. These results agree fairly well with experimental data on (p,γ)-reactions, available in this energy region, and a closer agreement of the integrated cross-section is obtained by adding to the single particle part the compound nucleus contribution for the process in question. The radiation from compound nucleus states contributes a non-negligible amount up to about 15 MeV incident energy. The presence of an absorbing part in the potential does not change the order of magnitude of the cross-section compared to the value obtained in a real potential, up to an absorption strength of $V_1 = 10.5$ MeV.

539.14

2684. EVALUATION OF SLATER INTEGRALS WITH HARMONIC OSCILLATOR WAVE FUNCTIONS. K.W.Ford and E.J.Konopinski.
Nuclear Phys., Vol. 9, No. 2, 218-24 (Dec. [1], 1958).

Formulae are given which make the evaluation of the expansion coefficients needed in the Talmi method of nuclear spectroscopy (Abstr. 8996/1952) simpler than heretofore. For the case of a Gaussian two-body potential, a formula is given which makes possible the direct evaluation of Slater integrals without recourse to the Talmi expansion.

539.14

2685. QUASI-LATTICE MODEL OF NUCLEAR MATTER.
L.E.H.Trainor, A.B.Bhatia and P.C.Sood.
Nuclear Phys., Vol. 9, No. 2, 287-95 (Dec. [1], 1958).

Brueckner and others (1956-8) have applied an extension of the self-consistent method of Hartree—Fock to the determination of the properties of a hypothetical nuclear matter consisting of roughly equal numbers of neutrons and protons, the electrical forces between protons being "turned off". Taking the nucleon—nucleon interaction potentials to be those of Gammel and Thaler, the authors applied the well-known Wigner—Seitz method for crystal lattices to a quasi-lattice model of nuclear matter. This method gives the energy of the lowest single-particle state as a function of the internucleonic separation. Good agreement is obtained with the experimental values for the nuclear density and the binding energy per nucleon.

539.14

2686. SCATTERING OF PROTONS IN A SPIN-ORBIT POTENTIAL.
G.W.Erickson and W.B.Cheston.
Phys. Rev., Vol. 111, No. 3, 891-7 (Aug. 1, 1958).

An approximation method is described for treating spin-orbit potentials in the optical model. The method is essentially a perturbation expansion using exact scattering amplitudes for a central optical potential as the unperturbed scattering amplitudes. The method is compared to an exact calculation and its usefulness in the medium-energy region demonstrated. The effects of a spin-orbit term on the differential cross-section and the spin polarization distribution are investigated as a function of the parameters involved in the medium-energy region. The polarization is shown to be approximately independent of the shape of the form factor of the spin-orbit term in this energy region. The reaction cross-section is insensitive to the inclusion of a spin-orbit term of reasonable depth.

539.14

2687. ON THE DISTRIBUTION OF THE NUCLEON DENSITY IN NUCLEI. F.I.Kligman.
Zh. eksper. teor. Fiz., Vol. 35, No. 2(8), 367-71 (1958). In Russian.

The distribution of the orbital momenta in nuclei is considered on the basis of the statistical nuclear model with the use of various distribution functions of the nucleon density. It is shown that reasonable nucleon density distribution functions can be chosen which satisfy the experiments on scattering of fast electrons by nuclei, the condition of saturation of nuclear forces and the fundamental requirements of the shell nuclear model.

539.14 : 530.145

VARIATIONAL METHODS AND THE NUCLEAR MANY-BODY PROBLEM. See Abstr. 2095

539.14

2688. NUCLEAR BINDING ENERGY IN THE REGION OF THE 82 PROTON AND 126 NEUTRON MAGIC NUMBERS.
R.A.Demirkhanov, T.I.Gutkin and V.V.Dorokhov.
Zh. eksper. teor. Fiz., Vol. 35, No. 4(10), 917-25 (1958). In Russian.

Results of measurement of the masses of the isotopes of bismuth, lead, thallium and mercury performed on a mass spectrograph of resolving power of 60 000-80 000 are presented. The masses of these isotopes were determined by direct comparison with the masses of the corresponding organic compounds. The masses of the Pb^{206}, Pb^{207} and Pb^{208} isotopes from various doublets are internally consistent. The binding energy of the nuclei computed from the measured masses of the isotopes confirms the shell structure of the nucleus with a filled shell of 82 protons and 126 neutrons. The difference of the nuclear binding energy for an even and odd number of nucleons in the nucleus and its smoothing out as the shell is filled up can be seen distinctly. After the shell is filled up with Z = 82 and N = 126 the binding energy of the following neutron is greater than the binding energy of the next proton. The energy of two bound neutrons (which yields the Hg^{204} nucleus) is greater than the energy of attachment of two protons (Pb^{204} nucleus).

539.14

2689. ON THE SPIN PROPERTIES OF NUCLEI. L.Meichsner.
Nuclear Phys., Vol. 8, No. 5, 493-594 (Nov. [1], 1958). In German.

The motion of nucleons in a non-spherical potential is considered. Without changing the dynamical variables of the nucleons, the Hamiltonian and the magnetic moment operator are put into such a form as to contain collective rotations about axes perpendicular to a body-fixed axis. The transformation yields operators for the tensor Θ of the reciprocal moment of inertia, for a vector W connecting the collective and the individual motions of the nucleons, and for the gyromagnetic tensor G. These quantities are calculated. A set of so-called approximate basis functions describing an independent motion of the nucleons with respect to a rotating system of coordinates and being in accordance with the symmetry properties of the problem is established. Matrix elements of the Hamiltonian and of the nuclear moment operators are calculated. The errors resulting from the occurrence of redundant degrees of freedom are eliminated by the formalism. A typical feature is the appearance of the so-called "Zwangsenergie". The transformation formalism and the approximate basis functions are used to calculate the ground state of Sc^{45}. An orthonormal set of single-particle functions containing a deformation parameter and a spin—orbit decoupling factor is established. The ground-state function is a linear combination of five approximate basis functions. The function corresponding to the lowest energy clearly predominates. A comparison with the undeformed shell model shows that the calculated energy is too high. This fact seems to be due essentially to the oscillator potential, which does not hold in this region of nucleon numbers. The calculated magnetic moment is in good agreement with the experimental value. The results are discussed, and some other consequences of the formalism are mentioned. A sketch on rotational states is added and also a discussion of some other papers.

539.14

2690. SPIN OF NEPTUNIUM-238.
R.G.Albridge, J.C.Hubbs and R.Marrus.
Phys. Rev., Vol. 111, No. 4, 1137-9 (Aug. 15, 1958).

The atomic-beam magnetic-resonance method was used to investigate 2.10 day Np^{238} in the low-field or Zeeman region of hyperfine structure. The spin of this nuclide is found to be 2.

539.14

2691. SPIN AND MAGNETIC DIPOLE MOMENT OF 2.6 hr Mn^{56}.
W.J.Childs, L.S.Goodman and L.J.Kieffer.
Phys. Rev. Letters, Vol. 1, No. 8, 296 (Oct. 15, 1958).

539.14

2692. SOME OBSERVATIONS ON THE BLOCH—SIEGERT EFFECT AND ITS EFFECT ON DOUBLE FREQUENCY EXPERIMENTS.
A.Lösche.
Ann. Phys. (Leipzig), Vol. 20, No. 1-6, 178-83 (1957). In German.

A method is described for calculating the intensity of the h.f. magnetic field in a nuclear magnetic resonance apparatus from the separation of the sideband lines when the h.f. field is amplitude modulated at a known frequency.

A.J.Manuel

539.14

2693. LEVEL INVERSION IN THE HYPERFINE STRUCTURE OF BROMINE-76. NUCLEAR MOMENTS OF BROMINE-76.
H.L.Garvin, T.M.Green, E.Lipworth and W.A.Nierenberg.
Phys. Rev. Letters, Vol. 1, No. 8, 293-5 (Oct. 15, 1958).

Of the three hyperfine levels F = $2\frac{1}{2}$, $1\frac{1}{2}$, $\frac{1}{2}$ of Br^{76} it has been found that the $1\frac{1}{2}$ and $\frac{1}{2}$ levels are inverted. Using an atomic beam apparatus and nuclear magnetic resonance three "flop in" transitions (F,m) $(2\frac{1}{2}, -\frac{1}{2}) \leftrightarrow (2\frac{1}{2}, -1\frac{1}{2})$; $(1\frac{1}{2}, 1\frac{1}{2}) \leftrightarrow (1\frac{1}{2}, \frac{1}{2})$; $(\frac{1}{2}, \frac{1}{2}) \leftrightarrow (\frac{1}{2}, -\frac{1}{2})$ were observed. The electric quadrupole interaction constants and the hyperfine separation were measured, and the electric quadrupole moment and magnetic dipole moment were calculated to be 0.55±0.02 nuclear magnetons, and 0.27±0.01 barn respectively.

R.W.Nicholls

539.14

2694. THE GYROMAGNETIC RATIO OF THE 92 keV LEVEL IN Pm^{147}.
E.Bodenstedt, E.Matthias, H.J.Körner and R.H.Siemssen.
Z. Naturforsch., Vol. 13a, No. 5, 425-6 (May, 1958). In German.

The shift of the γ—γ angular correlation in the 92 keV level of Pm^{147}, produced by an external magnetic field is measured for 7 angles between 60^{0} and 230^{0}, and a g-factor value of +0.43 ± 0.15 calculated.

S.J.St-Lorant

539.14

2695. THE NUCLEAR MOMENTS OF THE RARE Lu^{176} ISOTOPE AND OF Lu^{175}. A.Steudel.
Naturwissenschaften, Vol. 44, No. 13, 371-2 (1957). In German.

The hyperfine structure of the Lu spectrum was examined using a photoelectric Fabry—Perot interferometer. The angular momentu of Lu^{176} is probably 6 (the values 5 and 7 cannot be completely excluded). For Lu^{175}: $\mu_I{}^{175}$ = (2.0 ± 0.2) nuclear magnetons, and Q^{175} = (5.6 ± 0.5) × 10^{-24} cm^2. The ratios are: $\mu_I{}^{175}/\mu_I{}^{176}$ = 0.7174 ± 0.0015 and Q^{175}/Q^{176} = 0.70 ± 0.04.

A.O.Stanesby

539.14

2696. THE DETERMINATION OF THE ELECTRIC QUADRUPOLE MOMENT OF THE Zn^{67} NUCLEUS BY MEASUREMENT OF THE HIGH FREQUENCY TRANSITIONS IN THE 4^3P_1 STATE OF THE Zn^{67} ATOM. K.Böckmann, H.Krüger and E.Recknagel.
Ann. Phys. (Leipzig), Vol. 20, No. 1-6, 250-7 (1957). In German.

The resonance frequencies for the two magnetic dipole transitions between the hyperfine structure terms of the metastable 4^3P_1 term of the Zn^{67} atom were measured by observing the change in the anisotropy of the 4^3P_1—4^1S_0 fluorescence radiation excited by linearly polarized radiation in Zn^{67}-enriched Zn vapour, when the frequency of an applied h.f. magnetic field was varied. From the results the electric quadrupole moment of the Zn^{67} nucleus was calculated to be (0.18 ± 0.02) × 10^{-24} cm^2.

A.J.Manuel

539.14

2697. ELECTRIC POLARIZABILITY OF ATOMIC NUCLEI.
A.M.Baldin.
Nuclear Phys., Vol. 9, No. 2, 237-41 (Dec. [1], 1958).

A quantitative estimate is given of the effects depending on the existence of a tensor (spin-dependent) part in the electric polarizability of nuclei.

539.14

2698. ON THE MOMENT OF INERTIA OF A NON-SPHERICAL NUCLEUS. Yu.K.Khokhlov.
Zh. eksper. teor. Fiz., Vol. 35, No. 1(7), 240-3 (1958). In Russian.

The expression for the nuclear moment of inertia proposed by Inglis is computed by the perturbation theory procedure in an approximation including the square of the non-sphericity parameters. For the potential of the independent particle model a square well with infinitely high walls is taken. The calculated moment of inertia of the closed shells exceeds the hydrodynamical value by several times

539.14

2699. AN INTERPRETATION OF THE LOW-LYING EXCITED STATES OF Mg^{25} AND Al^{25}.
A.E.Litherland, H.McManus, E.B.Paul, D.A.Bromley and H.E.Gove.
Canad. J. Phys., Vol. 36, No. 3, 378-404 (March, 1958).

A description of the experimental results obtained for Mg^{25} and Al^{25} is given based upon the assumption that the excited nuclear state are rotational states. In Mg^{25} and Al^{25} members of four rotational bands can be identified. The band based on the ground state can be assigned K = 5/2 whilst the three excited-state bands, two positive parity and one negative parity, can be assigned K = 1/2. The dipole γ-ray transitions between the K = 1/2 bands and the ground-state K = 5/2 band are forbidden on the rotational model and it is a salient feature of the γ-ray cascading in Mg^{25} and Al^{25} that the ground-state transitions are always amongst the weakest transitions from excited states assigned to K = 1/2 bands. Besides giving a quantitative account of the γ-ray decay of the excited states the rotational model also predicts the number and type of the bands observed. The experimental values of the Mg^{24}(d,p)Mg^{25} deuteron stripping reduced widths can also be approximately predicted by the model.

539.14

2700. MAGNETIC TRANSITIONS BETWEEN COLLECTIVE EXCITED STATES IN EVEN-EVEN NUCLEI.

A.S.Davŷdov and G.F.Filippov.

Zh. eksper. teor. Fiz., Vol. 35, No. 3(9), 703-6 (1958). In Russian.

The reduced probability of a M1-transition between $2^+, 2^+$ states and the ratio of the probability of this transition to that of an E2-transition between the same states are computed. The small magnitude of this ratio agrees with the experimental data.

539.14 : 539.17

2701. SOME PROPERTIES OF THE 2.23 MeV EXCITED STATE OF P^{31}.

A.E.Litherland, E.B.Paul, G.A.Bartholomew and H.E.Gove.

Canad. J. Phys., Vol. 37, No. 1, 53-62 (Jan., 1959).

The 2.23 MeV excited state of P^{31} was studied by means of the capture gamma rays from the 1.70 MeV resonance in the reaction $Si^{30}(p,\gamma)P^{31}$. The angular correlation of the ground state gamma ray established that the resonance had total angular momentum 3/2, and triple correlation measurements of the cascading gamma rays from the compound state showed that the angular momentum of the 2.23 MeV state was 5/2. Coincidence measurements showed that the cascade gamma rays from the 2.23 MeV state to be the first excited state at 1.27 MeV were $\leq 3\%$ of the transitions to the ground state.

539.14

2702. EXCITED STATES OF Pt^{192}.

M.Kawamura, A.Aoki and T.Hayashi.

J. Phys. Soc. Japan, Vol. 13, No. 10, 1071-6 (Oct., 1958).

The directional correlations of the 300 keV—300 keV, 468 keV—316 keV and 300 keV—600 keV gamma—gamma cascades in Pt^{192} were measured using a coincidence spectrometer. It is found that the spins of the 784 keV and 920 keV levels are 4 and 3 respectively.

539.14

2703. THE CHARACTERISTIC LEVEL AND THE NUCLEAR LEVEL DENSITY.

M.El-Nadi and M.Wafik.

Nuclear Phys., Vol. 9, No. 1, 22-31 (Nov. [3], 1958).

The suggestions put forward by Bethe and Hurwitz (Abstr. 5782/1951) that level densities ought to be measured from a standard energy, such as is given by the semi-empirical formula, and not from nuclear ground states,is considered. The semi-empirical formula is corrected, following Fong (Abstr. 4629/1956), and this "characteristic level" is determined for nuclei from A = 10 to A = 250. The experimental data of Hughes et al (Abstr. 687/1954) for the fast neutron cross-sections are used to determine the level densities for the corresponding nuclei. These were found to be in agreement with the Fermi-gas model.

539.14

2704. THE LEVELS OF Na^{23} ON THE UNIFIED MODEL.

E.B.Paul and J.H.Montague.

Nuclear Phys., Vol. 8, No. 1, 61-4 (Sept. [1], 1958).

An attempt has been made to describe the levels of Na^{23} on the rotational model. Using the known quadrupole moment and reasonable values for the moment of inertia the levels are described in terms of $K = \frac{1}{2}, \frac{3}{2}$ and $\frac{5}{2}$ bands with perturbation due to rotation-particle coupling. L.L.Green

539.14

2705. LOW-LYING EXCITED STATES OF Na^{22}.

G.M.Temmer and N.P.Heydenburg.

Phys. Rev., Vol. 111, No. 5, 1303-8 (Sept. 1, 1958).

Using the singly and doubly ionized helium beams as well as a He^3 beam from our electrostatic generator, a study was made of the low-lying level structure of Na^{22} in the $F^{19}(\alpha,n\gamma)Na^{22}$ and $Ne^{20}(He^3,p\gamma)Na^{22}$ reactions, respectively. One excited state at 666 ± 4 keV was found in addition to most other states previously discovered in the self-conjugate reaction $Mg^{24}(d,\alpha)Na^{22}$ which presumably yields only states having T = 0. This state is believed to be the 0^+ analogue of the ground states of the two neighbouring even—even nuclei forming the T = 1 triplet at A = 22. By various coincidence experiments, this state is found to decay by a 73 keV transition, having a probable half-life of 0.014 μsec, to the first-excited state of Na^{22} at 593 keV, which in turn decays to the 3^+ ground state with a half-life of 0.266 ± 0.010 μsec. With the plausible assignment of 1^+ for the 593 keV state (0^+ being completely ruled out by the half-life) this would represent a pure M1—pure E2 cascade, whose strengths would be 0.0045 and 0.0077 single-particle units, respectively. The location of the first T = 1 state occurs exactly as expected from a systematic study of the A = 4n + 2 series Coulomb-energy differences, lending additional support to the $I = 0^+$, T = 1 assignment. Proton groups to most previously known states were observed, together with one new one at 3.75 MeV. A number of higher energy gamma rays were found in coincidence with those already mentioned, which one can interpret within the framework of known excited states.

539.14

2706. PRECISION DETERMINATION OF NUCLEAR ENERGY LEVELS IN HEAVY ELEMENTS.

E.L.Chupp, J.W.M.DuMond, F.J.Gordon, R.C.Jopson and H.Mark.

Phys. Rev., Vol. 112, No. 2, 518-31 (Oct. 15, 1958).

The low-lying energy levels in 32 isotopes between Z = 62 and Z = 75 was studied using a high-precision bent quartz crystal spectrograph to determine gamma-ray energies. The gamma-rays were produced by the electric (or Coulomb) excitation process. A high proton-beam current was used to provide the intense sources necessary for these experiments. With this technique, energies in the 100 keV region can be determined with a precision of about one part in 2000. A comparison of the results with the unified model of nuclear structure is given.

539.14 : 539.17

2707. ENERGY LEVELS IN F^{18} FROM THE $N^{14}(\alpha,\alpha)N^{14}$ AND $N^{14}(\alpha,p)O^{17}$ REACTIONS.

E.Kashy, P.D.Miller and J.R.Risser.

Phys. Rev., Vol. 112, No. 2, 547-52 (Oct. 15, 1958).

Elastically scattered alpha particles from N^{14} and ground-state protons from the $N^{14}(\alpha,p)O^{17}$ reaction show resonances at 2.88, 3.09, 3.60, 3.67, 3.72, 4.00, 4.05, 4.11, 4.28, 4.50 and 4.55 MeV bombarding energies, corresponding to excited states of the F^{18} nucleus at 6.65, 6.82, 7.21, 7.27, 7.30, 7.52, 7.56, 7.61, 7.74, 7.91 and 7.95 MeV. Scattering-matrix analysis of the elastically scattered alpha-particles, together with angular distributions of the reaction protons, indicate that the 6.65, 6.82, 7.21, 7.27, 7.30, 7.52, 7.91 and 7.95 MeV states in F^{18} probably have angular momenta and parities of 1^-, 2^-, 4^+, 1^+, 3^-, 3^-, 2^-, and 1^+, respectively.

539.14

2708. 4+ EXCITED STATE IN OSMIUM-188.

P.S.Fisher and R.A.Naumann.

Phys. Rev., Vol. 112, No. 5, 1717-19 (Dec. 1, 1958).

Transitions in Os^{188} excited by the K capture from 41 hr Ir^{188} were observed at 155, 324, 478, 633, 641, 827, 832, 1205, 1320, 1440, 1560, 1700, 1940, 2055, and 2190 keV. The new transition at 423 keV is in prompt coincidence with the 155 keV transition to the ground state, and an E2 assignment was made from conversion electron and gamma-ray intensities. It is proposed that this is the transition between a 4+ rotational level in Os^{188} at 479 keV and the 2+ state at 155 keV.

539.14

2709. LINEAR RELATIONSHIPS BETWEEN NUCLEAR ENERGY LEVELS.

F.Everling.

Z. Naturforsch., Vol. 13a, No. 10, 900-2 (Oct., 1958). In German.

In order to show relationships between nuclei with the same neutron excess, the quantity CA—B is plotted for ground and low excited levels. Here C is an arbitrary constant, A is the mass number and B is the binding energy of the state. G.E.Brown

539.14

2710. ROTATIONAL STATES OF NON-AXIAL NUCLEI.

A.S.Davŷdov and G.F.Filippov.

Zh. eksper. teor. Fiz., Vol. 35, No. 2(8), 440-7 (1958). In Russian.

A theory of the energy states and electromagnetic transitions between them is developed for nuclei which do not possess axial symmetry. It is shown that violation of axial symmetry of the nucleus may not appreciably change the rotational states of axial nuclei but leads to the appearance of new energy states. Comparison of the theory with experiment indicates that the so-called γ-vibrational energy levels of even-even nuclei should be regarded as rotational levels. The levels of some nuclei with a sequence of spins 0, 2, 2, 3 should be ascribed to the same type.

539.14 : 539.163.1

LIFETIME MEASUREMENTS OF THE FIRST EXCITED STATES OF Tl^{208} AND Ra^{224}.

See Abstr. 1732

539.14

2711. HYPERFRAGMENT BINDING ENERGIES.

S.Limentani, P.E.Schlein, P.H.Steinberg and J.H.Roberts.

Nuovo Cimento, Vol. 9, No. 6, 1046-53 (Sept. 16, 1958).

A study of hyperfragments was made in a 10 in^3 stack of Ilford G5 emulsion which was exposed to the Berkeley 4.7 GeV/c

π^- beam. In area scanning 66 500 interaction stars, 37 hyperfragments (12 mesonic decays — 25 non-mesonic decays) and 61 other secondary events ("goks") with connecting tracks $< 15\,\mu m$ were found. Some fraction of these 61 goks (undetermined in this study) represent hyperfragments. Binding energies for 6 of the mesonic hyperfragments were obtained. Three of these binding energies are for $Z \geq 3$.

539.14

2712. DECAYS OF HYPERFRAGMENTS IN NUCLEAR EMULSION. C.Grote.
Nuovo Cimento, Vol. 10, No. 4, 652-8 (Nov. 16, 1958).

Seven decays of hyperfragments were found in Ilford G-5 emulsion. Five events are uniquely defined decays. Within the limits of error the binding energies agree with the results of other authors.

539.14

2713. TWO EVENTS OF MESONIC DECAY OF HYPERFRAGMENTS IN FLIGHT.
A.Filipkowski, E.Skrzypczak, A.Somogyi and A.Wróblewski.
Nuclear Phys., Vol. 7, No. 6, 643-5 (Aug., 1958).

From 553 stars produced by 300 MeV/c K^--mesons in G5 emulsion, two hyperfragments were observed to decay in flight. One was $H^4 \rightarrow \pi^- + He^4$, the other most probably either $H^3 \rightarrow \pi^- + p + p + n$ or $H^4 \rightarrow \pi^- + d + p + n$. E.J.Burge

539.14

2714. Λ—NUCLEON INTERACTION IN THE HYPERNUCLEUS ${}_\Lambda Be^9$. K.S.Suh.
Phys. Rev., Vol. 111, No. 3, 941-3 (Aug. 1, 1958).

A variational method has been used to calculate the strength of the Λ—nucleon interaction required to account for the observed binding of ${}_\Lambda Be^9$. The hypernucleus is treated as a three-body system (two alpha-particles and the hyperon), in which the spin-average of the Λ—nucleon interaction is effective. Results in agreement with previous calculations of the Λ—nucleon interaction in ${}_\Lambda He^5$ are obtained without appreciable overlapping of the two alpha-particles. This absence of overlapping is taken to be a reasonable criterion for the validity of the model.

539.14

2715. OBSERVATION OF A π^0-MESONIC DECAY OF A HELIUM HYPERNUCLEUS. R.Levi Setti and W.E.Slater.
Phys. Rev., Vol. 111, No. 5, 1395-7 (Sept. 1, 1958).

The observation of a hypernucleus decaying into an electron pair, a recoil, and one or more neutral particles, is reported here. The event was produced by a K^- capture in emulsion. The charge of the hypernucleus was determined as $Z = 2$. The most probable interpretation of this unusual event is the reaction ${}_\Lambda He^4 \rightarrow \pi^0 + He^4$. However, ${}_\Lambda He^{4,5} \rightarrow \pi^0 + n + He^{3,4}$ cannot be ruled out, since a reliable determination of the energy of the electrons at emission cannot be made.

539.14

2716. π^+-MESONIC DECAY OF A HYPERFRAGMENT.
J.Schneps.
Phys. Rev., Vol. 112, No. 4, 1335-6 (Nov. 15, 1958).

The hyperfragment was produced in a negative K-meson star in emulsion, and it decayed into two visible particles, a π^+-meson and a recoil. It can be interpreted as ${}_\Lambda Li^7 \rightarrow n + \pi + He^6$, or ${}_\Lambda Be^7 \rightarrow n + \pi^+ + Li^6$. Since the Λ-particle decays only into $p + \pi^-$ and $n + \pi^0$, the appearance of a π^+-meson from this hyperfragment is explained as due to the charge exchange of a π^0-meson from the Λ-decay with the residual nucleus of the hyperfragment.

539.14

2717. MESON THEORY OF THE BINDING ENERGY OF LIGHT HYPERNUCLEI. V.A.Lyul'ka and V.A.Filimonov.
Zh. eksper. teor. Fiz., Vol. 34, No. 4(10), 1026-30 (1958).
In Russian.

The binding energy of Λ-particles in the hypernuclei H_Λ^3, H_Λ^4, He_Λ^4 and He_Λ^5 was computed in the second and fourth order of perturbation theory. The results of the theoretical calculations are in satisfactory agreement with the experimental data.

539.14 : 539.12

PARITY NONCONSERVATION IN THE DECAY OF FREE AND BOUND Λ PARTICLES. See Abstr. 2657

RADIOACTIVITY

539.16

2718. CHEMISTRY AND THE ATOMIC NUCLEUS. W.F.Libby.
Amer. J. Phys., Vol. 26, No. 8, 524-36 (Nov., 1958).

An informal account is given of the development of the Berkeley school of science and radiochemistry, followed by a summary of the results of radiocarbon dating measurements in relation to archaeological problems. A few suggestions are made as to future potential uses of radioisotope techniques in science and in industry.

539.16.0

2719. THE PREPARATION AND MAINTENANCE OF STANDARDS OF RADIOACTIVITY. W.B.Mann.
Internat. J. appl. Radiation and Isotopes, Vol. 1, No. 1-2, 3-23 (July, 1956).

A historical survey is made of the preparation and measuremen of international radium standards. The need for standards of other radioisotopes is explained. Standardization is subdivided into prima and secondary methods; $4\pi\beta$ counting, β—γ and γ—γ coincidence counting, gas counting, and microcalorimetry are discussed as primary methods, and the maintenance of standards thus obtained is considered. The present state of international comparison of severa radioisotopes is reported and discussed, together with a policy for wider international standardization.

539.16.08

2720. THE APPLICATIONS OF STANDARDS OF RADIOACTIVITY. H.H.Seliger.
Internat. J. appl. Radiation and Isotopes, Vol. 1, No. 3, 215-32 (Nov., 1956).

The application of standards of radioactivity for (a) determination of absolute efficiencies of detectors, (b) determination of long half-lives, and (c) determination of mean energies are reviewed. Most of the available isotopes are listed and methods of routine assay are suggested. The various types of detectors used for routine radioactivity assay in the laboratory are discussed and their efficiencies are evaluated. Techniques are suggested for the prepara tion of "laboratory standards" from the standards issued by the National Bureau of Standards. The use of simulated standards in both beta- and gamma-ray measurements is described.

539.163 : 539.167

2721. RADIOACTIVE ISOTOPES OF RHENIUM AND OSMIUM FORMED BY THE BOMBARDMENT OF RHENIUM WITH PROTONS.
J.S.Foster, J.W.Hilborn and L.Yaffe.
Canad. J. Phys., Vol. 36, No. 5, 555-64 (May, 1958).

Targets of normal rhenium, and of rhenium enriched in each stable isotope, were bombarded by protons in the energy range 10 to 80 MeV. These produced osmium and rhenium nuclides of masses 185, 183, 182, 181, and 180. After chemical separations, the gamma-rays and conversion electrons were examined for half-lives, and to determine certain conversion coefficients. Independent isomers of Os^{183} with 10 and 15.4 hr half-lives were found. Gamma-rays with energies 168.1, 850, and 1097 keV were assigned to the 10 hr isomer, and gamma-rays with energies 114.6, 168.7, and 382.4 keV were assigned to the 15.4 hr isomer. In addition, the half-lives of Os^{185}, Os^{182}, and Re^{183} were observed to be 93.4 days, 21.9 hr, and 67.6 days respectively. Activities with half-lives of 19 hr, 23 min, 18 min, and 2 min were tentatively assigned to Re^{181}, Os^{181}, Re^{180}, and Os^{180} respectively.

539.163

2722. DISCOVERY OF Pr^{137}.
C.Dahlstrom, J.S.Foster and A.L.Thompson.
Canad. J. Phys., Vol. 36, No. 11, 1483-6 (Nov., 1958).

The neutron-deficient isotope Pr^{137} was discovered by proton bombardment of natural cerium, chemical separation, and mass determination. Its half-life is 1.5 ± 0.1 hours and the end-point of its positron spectrum is 1.7 ± 0.1 MeV. No gamma-rays were observed. See also following abstract.

539.163

2723. SUCCESSIVE DECAYS FROM Pr^{137} AND Ce^{137m}. DECAY OF ADJACENT PRASEODYMIUM ISOTOPES.
G.T.Danby, J.S.Foster and A.L.Thompson.
Canad. J. Phys., Vol. 36, No. 11, 1487-508 (Nov., 1958).

The decay of Pr^{137} entirely to a 9.0 hr ground state of Ce^{137} was independently discovered. By allowed electron capture, Ce^{137} decays predominantly to a low-lying state of La^{137}, with only a 3% branching to a 440 keV excited state. The 440 keV transition is at least predominantly E2 in character. A 34.4 hr isomeric state produced by the $La^{139}(p,3n)Ce^{137m}$ reaction decays by a 254.5 keV M4-transition to the 9 hr ground state. A 0.6% branching was found from the isomeric state directly to a small group of apparently high-spin states in La^{137}. Studies of mass-separated isotopes confirmed the existence of 1.5 hr Pr^{137} and 1.0 hr Pr^{136}. The K-capture to positron branching ratios observed in the decay of Pr^{139}, Pr^{138}, Pr^{137}, and Pr^{136} show that these isotopes decay by allowed transitions to their cerium daughters. Characteristic gamma-rays were observed.

539.163

2724. GENETIC MEASUREMENT OF THE HALF LIFE OF Bi^{207}.

J.Sosniak and R.E.Bell.

Canad. J. Phys., Vol. 37, No. 1, 1-4 (Jan., 1959).

The half-life was measured using the parent—daughter pair Po^{207} and Bi^{207}. Both activities are electron capturers, and the measured half-life depends only on the activity ratio between them. The value found, $T_{1/2} = 28 \pm 3$ years, agrees with one of three previous determinations of this half-life.

539.163 : 539.14

2725. RADIATION OF Co^{55}. A.Mukerji, V.S.Dubey and S.S.Malik.

Phys. Rev., Vol. 111, No. 5, 1319-24 (Sept. 1, 1958).

The radiations were studied in a thin lens magnetic beta-ray spectrometer and in coincident scintillation spectrometers. By observation of the internal conversion lines and the unconverted gamma-spectrum, gamma-rays of energies 1410, 937, 476, and 247 keV were resolved. No other gamma-ray of higher energy decaying with an 18 hr half-life could be observed after careful search of that region using a 4½ in. diameter and 4 in. thick NaI(Tl) crystal. The Fermi—Kurie analysis of the positron spectrum yielded three groups of positrons of maximum energies 1510 (51%), 1040 (45%) and 790 (4%) keV. These measurements revealed energy levels of the residual nucleus, Fe^{55}, at 937, 1410, and 1657 keV.

539.163 : 539.17

HALF-LIVES AND SPECTRA OF Na^{26} AND Ne^{23}. See Abstr. 1779

539.163.1

2726. DECAY OF Ga^{65}. I. HALF-LIFE AND β-SPECTRUM.

H.Daniel.

Z. Naturforsch., Vol. 12a, No. 5, 363-5 (1957). In German.

The half-life determinations yielded the value of 15.2 ± 0.2 min. The continuum β^+ has been resolved in four groups. F.Lachman

539.163.1

2727. DECAY OF Ga^{65}. II. γ-SPECTRUM AND MEASUREMENTS OF COINCIDENCES. T.Mayer-Kuckuk.

Z. Naturforsch., Vol. 12a, No. 5, 365-7 (1957). In German.

Lines of (118 ± 3), (738 ± 6), (906 ± 8), (1378 ± 30) and (1858 ± 30) keV were found in the γ-spectrum of Ga^{65} by means of a scintillation spectrometer. Measurements of coincidences were carried out using two scintillation spectrometers. A provisional decay scheme is proposed. F.Lachman

539.163.1

2728. ON THE DETERMINATION OF THE HALF-LIFE OF Re^{187}.

W.Herr and E.Merz.

Z. Naturforsch., Vol. 13a, No. 3, 231-3 (March, 1958). In German.

The half-life of the low-energy β-decay of Re^{187} was determined by a chemical method. A special neutron activation technique enabled the quantitative detection of the trace elements, Re and Os, to be measured to 10^{-7}%. The age of the minerals bearing the Re was determined by the U/Pb method. These measurements gave a half-life of $6.2 \pm 0.6 \times 10^{10}$ years. The ages of a number of minerals were determined by the Re/Os method and compared with earlier results by other methods. D.H.Lord

539.163.1

2729. ON THE DETERMINATION OF THE β-HALF-LIFE OF Lu^{176} BY THE DETECTION OF RADIOACTIVE Hf^{176}.

W.Herr, E.Merz, P.Eberhardt and P.Signer.

Z. Naturforsch., Vol. 13a, No. 4, 268-73 (April, 1958). In German.

The Hf isotope frequency, the Lu^{176} and radioactive Hf^{176} contents were determined for several minerals (e.g. gadolinite) by ion exchange, neutron activation and mass spectroscopic methods. The ages of the minerals examined were measured using proven methods, such as the Pb^{206}/Pb^{207} and RaD methods. These results show that this is a possible method for geological dating, and gave the half-life of Lu^{176} as $(2.17 \pm 0.35) \times 10^{10}$ years. D.H.Lord

539.163.1

2730. ON THE HALF-LIFE OF THE LONG-LIVING Al^{26}.

R.A.Rightmire, T.P.Kohman and H.Hintenberger.

Z. Naturforsch., Vol. 13a, No. 10, 847-53 (Oct., 1958). In German.

The Al^{26} was obtained by irradiating pure magnesium with protons in a cyclotron and then chemically extracting the Al^{26} into solution. The specific positron activity of such a solution was obtained by observing the counting rate of a 4π Geiger counter as a function of absorber thickness. The total specific activity was obtained from this by correcting for electron absorption. The relative Al^{26} contents of the sample were found by a mass-spectroscopic analysis combined with the "isotope dilution" technique. These measurements gave the half-life of Al^{26} as $(7.38 \pm 0.29) \times 10^5$ years. D.H.Lord

539.163.2

2731. THE DECAY OF Os^{191} AND Os^{193}.

S.V.Nablo, M.W.Johns, A.Artna and R.H.Goodman.

Canad. J. Phys., Vol. 36, No. 10, 1409-29 (Oct., 1958).

The beta- and gamma-ray spectra of Os^{191} and Os^{193} were studied with a magnetic beta-ray spectrometer, scintillation spectrometers, and coincidence circuits. The 14 hr isomer of Os^{191} decays via a 0.0742 MeV (M3) transition. Gamma rays of energy 0.0418 (100%, E3), 0.0809 (1%, M1 + E2), 0.1287 (100%, M1 + E2) and 0.1858 (0.1%) MeV were found to be associated with the 14.6 ± 0.3 day decay of Os^{191} and an extension of the accepted decay scheme proposed. The following 19 transitions have been associated with the 31.5 ± 0.5 hour decay of Os^{193}: 0.0730 (14%), 0.1068 (~ 1%), 0.1393 (10%), 0.180 (0.3%), 0.196 (0.1%), 0.243 (~ 0.2%), 0.2485 (0.3%), 0.2514 (0.4%), 0.278 (0.6%), 0.2810 (1.6%), 0.2885 (0.3%), 0.2994 (0.4%), 0.314 (0.3%), 0.3218 (1.7%), 0.3620 (0.6%), 0.3878 (1.6%), 0.4604 (4.1%), 0.4857 (0.3%), and 0.5585 (2.2%). The internal conversion coefficients for all the stronger transitions suggest that they are M1 + E2 in character. The decay energy of Os^{193} is 1.132 ± 0.005 MeV. Fermi analyses and beta—gamma coincidence experiments have established excited states of Ir^{193} at 0.073, 0.139, 0.281, 0.362, 0.460 and 0.559 MeV above the ground state. Six otherwise unclassified weak gamma rays can be accommodated if levels at 0.247, 0.315, and 0.613 MeV are included in the decay scheme. The activation cross-sections of Os^{184} and Os^{190} are $(2.2 \pm 0.5) \times 10^3$ and 5.3 ± 2 barns respectively, relative to Seren's value of 1.6 ± 0.4 barns for Os^{192}.

539.163.2

2732. ON THE DECAY OF ^{185}W. A.Bisi and L.Zappa.

Nuovo Cimento, Vol. 10, No. 1, 90-5 (Oct. 1, 1958).

The γ-spectra from an electromagnetically enriched sample of W^{184} irradiated with reactor neutrons was investigated. The decay of the various radiations was followed for more than three half-lives of W^{185}. It was ascertained that the decay of W^{185} populates the first rotational level of Re^{185} at 125 keV with a branching ratio of about 0.3%. The K internal conversion of the γ-ray was found to be 2.9 ± 0.3.

539.163.2

2733. RADIOACTIVITY OF LEAD-205.

J.Wing, C.M.Stevens and J.R.Huizenga.

Phys. Rev., Vol. 111, No. 2, 590-2 (July 15, 1958).

Pb^{205} was produced by the $Pb^{204}(n,\gamma)Pb^{205}$ reaction in the Materials Testing Reactor. The Pb^{205}/Pb^{204} atom ratios of 0.001175 ± 0.000060 and 0.005064 ± 0.000063, respectively, were measured in a mass spectrometer for lead samples irradiated in the M.T.R. for approximately 3 months and 1 year. The neutron capture cross-section of Pb^{204} for M.T.R. neutrons is 0.7 ± 0.2 barn. The partial half-life of Pb^{205} for L electron capture is $(3.0 \pm 0.5) \times 10^7$ years. The K/L electron capture ratio of Pb^{205} is $\leq 6 \times 10^{-4}$, and the disintegration energy is probably less than 86 keV. No gamma-rays were observed in the decay of Pb^{205}.

539.163.2

2734. DECAY OF GADOLINIUM-159.

S.S.Malik, N.Nath and C.E.Mandeville.

Phys. Rev., Vol. 112, No. 1, 262-6 (Oct. 1, 1958).

The decay was studied with the aid of a thin magnetic lens beta-ray spectrometer and coincident scintillation spectrometers. Two principal beta-ray groups, with the end point energies 580 ± 10 and 940 ± 15 keV were observed to decay with the 18 hr half-life of Gd^{159}, revealing energy levels in the residual nucleus, Tb^{159}, at 56, 136, and 361 keV. The coincidence measurements gave evidence of a third beta component, with the end point energy of 880 ± 20 keV, coincident with the 56 keV gamma ray. The intensities of the three components (580 ± 10, 880 ± 20, and 940 ± 15 keV) have been estimated to be approximately 20, 6 and 74%, respectively. Internal conversion coefficient measurements indicated the 361 keV gamma ray to be a mixed (M1 and E2) transition.

539.163.2

2735. Al^{26} DECAY SCHEME. J.M.Ferguson.
Phys. Rev., Vol. 112, No. 4, 1238-40 (Nov. 15, 1958).

The energies and intensitites of the beta and gamma radiations from the long-lived ground level of Al^{26} were studied with scintillation spectrometers. The positron spectrum was obtained using a plastic scintillator with 4π geometry and was found to have a forbidden shape and an endpoint of 1.160 ± 0.008 MeV. The positrons are in coincidence with a gamma-ray with an energy of 1.84 ± 0.01 MeV, which is presumably from the first excited level of Mg^{26}. There is also a weak gamma ray with an energy of 1.10 ± 0.05 MeV, in coincidence with the 184 MeV gamma-ray, and with an intensity of 0.03 relative to the 1.84 MeV gamma-ray. This would be from the second excited level of Mg^{26}, to which the Al^{26} decays weakly by electron capture. No other gamm-rays are observed. It appears that a peak in the pulse-height spectrum at 700 keV is due to scattering effects rather than a gamma-ray photopeak.

539.163.2

2736. GAMMA-RAY BRANCHING AND SOME SPIN AND PARITY ASSIGNMENTS IN B^{11}. A.J.Ferguson, H.E.Gove, J.A.Kuehner, A.E.Litherland, E.Almqvist and D.A.Bromley.
Phys. Rev. Letters, Vol. 1, No. 11, 414-15 (Dec. 1, 1958).

The decay modes of levels in B^{11} were studied by the $Be^9(He^3,p\gamma)B^{11}$ and $Li^7(\alpha,\gamma)B^{11}$ reactions. These are interpreted on the basis of a decay scheme involving 11 excited states up to 9.28 MeV. Gamma-ray angular distribution measurements were also made and spins and parities of some of the levels are proposed. M.A.Grace

539.163.2

2737. A NEW ISOTOPE OF OSMIUM WITH 6.5 MINUTE HALF-LIFE (Os^{195}). G.Baró and P.Rey.
Z. Naturforsch., Vol. 12a, No. 6, 520 (1957). In German.

This isotope is found by irradiation of Pt^{198} with fast neutrons (n, α reaction). It is a β^--emitter of maximum energy 2 MeV. J.R.Mallard

539.163.2

2738. ON THE DECAY SCHEME OF Mo^{99}.
I.V.Éstulin, G.M.Chernov and Z.V.Pastukhova.
Zh. eksper. teor. Fiz., Vol. 35, No. 1(7), 71-7 (1958). In Russian.

The angular correlation of 742-180 keV γ-quanta emitted in the decay of Mo^{99} was measured. By chemical separation of Tc^{99m}, it is proved that the β-transition in Mo^{99} with E_β = 1.23 MeV leads to an isomer level in Tc^{99} and (7 ± 1)% of the 140 keV γ-quantum intensity is not related to the isomeric transition. Arguments are presented which speak in favour of the following characteristics of the ground state of Mo^{99} $3/2^+$ and of the excited states of Tc^{99} of 922 keV energy: $3/2^+$ or $5/2^-$; and for the 180 keV energy: $7/2^+$.

539.164.2

2739. ALPHA-DECAY OF NON-SPHERICAL NUCLEI.
L.L.Gol'din, G.M.Adel'son-Vel'skii, A.P.Birzgal, A.D.Piliya and K.A.Ter-Martirosyan.
Zh. eksper. teor. Fiz., Vol. 35, No. 1(7), 184-202 (1958). In Russian.

A set of equations for radial functions which describe the motion of α-particles emitted in the α-decay of non-spherical nuclei with arbitrary spins is considered. Formulae are obtained which define the boundary conditions for the radial functions on the nuclear surface and also formulae which express the probability for α-decay in terms of the values of the radial functions on the nucleus and of the shape of the nucleus. A simple approximate formula is derived for the dependence of α-decay probability on the momentum l carried off by the α-particle and on the energy of the daughter nucleus. For even nuclei (spin 0) an analysis is carried out of the various ways of approximate solution of the equation set for the radial functions. It is shown that the terms which connect the equations (due to the non-spherical part of the Coulomb interaction between the α-particle and the nucleus) cannot be regarded as a perturbation for $l > 2$. An exact numerical solution of the equation set is carried out for an elliptic nucleus with account of all multipole interactions, the wave-function being assumed constant on the nuclear surface. The significance of higher harmonics is determined in the Legendre polynomial expansion of the equation on the nuclear surface. The results of the calculations are compared with the experiments.

539.165 : 539.1

2740. RADIATIONS OF OSMIUM-193 AND OSMIUM-191.
V.S.Dubey, S.S.Malik, C.E.Mandeville and A.Mukerji.
Phys. Rev., Vol. 111, No. 3, 920-4 (Aug. 1, 1958).

The radiations of Os^{193} and Os^{191} have been examined in a thi lens beta-ray spectrometer and in coincident scintillation spectrometers. Ten gamma-rays and seven beta-spectra have been dete ted in the decay of Os^{193}, revealing energy levels in Ir^{193} at 73, 138 356, 388, 458, and 558 keV. In order of decreasing end-point ener the relative intensities of the beta-spectra of Os^{193} are estimated 67, 6, 4, 2, 3, 13, and 5. The beta-ray spectrum of Os^{191} has been observed, and the K/L ratio of the 129 keV transition of Os^{191} has been measured as 2.4, corresponding to a mixture of 54% E2 in M

539.165 : 539.1

2741. $\beta-\gamma$ ANGULAR CORRELATION EXPERIMENTS AND TIM REVERSAL INVARIANCE OF THE BETA INTERACTION.
P.C.Simms and R.M.Steffen.
Phys. Rev. Letters, Vol. 1, No. 8, 289-90 (Oct. 15, 1958).

The anisotropy of the $\beta-\gamma$ correlation was measured for Au^{19} Measurements were also made of this angular correlation when th transverse polarization of the β-rays was observed. The result is discussed in relation to time-reversal invariance. M.A.Gra

539.165 : 539.1

2742. POLARIZATION CORRELATION OF β-PARTICLES AND γ-QUANTA IN ALLOWED DECAY OF ORIENTED NUCLEI.
A.Z.Dolginov.
Zh. eksper. teor. Fiz., Vol. 35, No. 1(7), 178-83 (1958). In Russia

Formulae are derived for the correlation between the polariza tion of β-particles and circular polarization of the subsequent γ-quanta in allowed β-decay of oriented nuclei.

539.1

2743. POSITRON SPECTRUM OF $Eu^{152,154}$.
D.L.Kaminskiĭ and M.G.Kaganskiĭ.
Zh. eksper. teor. Fiz., Vol. 35, No. 4(10), 926-31 (1958). In Russia

The spectrum of positrons emitted in the decay of $Eu^{152,154}$ was measured. The spectrum mainly consists of positrons due to pair conversion of 1410 keV γ-quanta and of a β^+-spectrum with an end point energy of E_0 = 700 ± 20 keV. The spectrum is identified as t due to positron decay of Eu^{152} ($T_{1/2}$ = 13 years), its intensity being 1.2×10^{-4} positrons per decay. For this transition log (τf) is 12.1

539.16

2744. TYPES OF INTERACTION IN β-DECAY.
N.A.Burgov and Yu.V.Terekhov.
Zh. eksper. teor. Fiz., Vol. 35, No. 4(10), 932-9 (1958). In Russian

Electron–neutrino correlation in the β-decay of Na^{24} was investigated by the method of nuclear resonance scattering of Mg^{24} γ-rays accompanying the β-decay of Na^{24}. A gaseous Na^{24} source was employed. The most probable value of the correlation constan was found to be $\lambda = -0.23 \pm 0.19$. The results of the investigation indicate that the only possible type of interaction involved in the β-transition of Na^{24} is axial-vector interaction which corresponds t $\lambda = -\frac{1}{3}$.

539.16

2745. THE RECOIL EFFECT OF THE NEUTRINO IN THE β-DECAY OF He^6. Yu.Chikai and A.Salai.
Zh. eksper. teor. Fiz., Vol. 35, No. 5(11), 1074-5 (1958). In Russia

539.165

2746. ON β-TRANSITIONS 0–0 WITH CHANGE OF PARITY.
B.V.Geškenbein.
Nuovo Cimento, Vol. 10, No. 2, 383-4 (Oct. 16, 1958).

It is shown that the form of the spectrum and the polarization o the electrons in 0–0 β-transitions is in agreement with a V–A type of interaction.

539.165.

2747. NUCLEAR POLARIZATION IN RADIATIVE K-CAPTURE.
V.B.Beresteckij.
Nuovo Cimento, Vol. 10, No. 2, 385-7 (Oct. 16, 1958).

A formula for the nuclear polarization in the process $e + p \rightarrow n + \nu + \gamma$ is given.

539.165.2

2748. TEST OF THE NATURE OF THE VECTOR INTERACTION IN β DECAY M.Gell-Mann.
Phys. Rev., Vol. 111, No. 1, 362-5 (July 1, 1958).

An experiment is proposed to test the theory advanced by Feynman and Gell–Mann (Abstr. 507/1958) on the vector interactio in β decay. According to the theory, the Fermi coupling constant is not appreciably altered by renormalization, in agreement with experiment. A further property of the theory is exploited here, that analogous γ and β transitions in light nuclei have proportional matrix elements, as far as the V interaction is concerned. In particular, the V interaction gives rise to "weak magnetism" analogous to the magnetic effects that induce the emission of M1 photons. This "weak magnetism" obeys Gamow—Teller selection rules and interferes with the A coupling, distorting the spectra of high-energy β transitions with $\Delta J = 1$ (no). It is suggested that the β-spectra of B^{12} and N^{12} be measured accurately and compared. Departure from linearity of the Kurie plot should be noticed in each case; the ratio of the spectra can be calculated with confidence on the basis of the theory, which predicts a 20% effect. The measured γ-ray width of the 15.11 MeV state in C^{12} is used in the calculation.

539.165.2

2749. β-DECAY OF N^{13} AND THE FIERZ INTERFERENCE IN THE FERMI INTERACTION. H.Daniel and U.Schmidt-Rohr.

Z. Naturforsch., Vol. 12a, No. 9, 750 (Sept., 1958). In German.

Short report on a β-spectroscopy experiment carried out in order to check the value of the coefficient of the Fierz interference in the Fermi interaction. A new set of more accurate values describing this transition is given. G.Martelli

539.166 : 551.594.14

2750. ON THE γ-RAY SPECTRA OF THE RADIOACTIVE FALL-OUT FROM THE ATMOSPHERE. W.Herbst and K.Sommermeyer.

Naturwissenschaften, Vol. 44, No. 14, 392 (1957). In German.

Similar γ-ray spectra have been recorded with ashed dust collecting foils and ashed grass. The relative peak heights are similar in both cases. The peaks can be ascribed to Ba^{140} + La^{140}(13d). Zr^{95} + Nb^{95}(65d), and Ru^{103}(40d). The relative peaks are characteristic for the age of the fall-out. The Ba^{140} + La^{140} peaks in particular are only found in the spectra of grass when these have been taken immediately after fall-out or during the first week or two after the mowing of the grass. The absolute intensities correspond to a γ-ray activity which is one half of the β-ray activity. R.Schnurmann

539.166

2751. GYROMAGNETIC RATIO OF THE 3.5×10^{-9} SEC STATE AND OTHER ANGULAR CORRELATION MEASUREMENTS OF Tc^{99}.

S.Raboy and V.E.Krohn.

Phys. Rev., Vol. 111, No. 2, 579-80 (July 15, 1958).

The gyromagnetic ratio of the 181 keV state of Tc^{99} is found to be $+1.5 \pm 0.2$ nuclear units. The angular correlation pattern obtained for the 740 and 181 keV pair of gamma rays is $W(\theta) = 1 + (0.067 \pm 0.004)P_2(\cos\theta) + (0.020 \pm 0.005)P_4(\cos\theta)$ and that of the 740 and 140 keV pair of gamma rays is $W(\theta) = 1 - (0.107 \pm 0.010) \times \times P_2(\cos\theta)$.

539.166

2752. GAMMA RAYS OF Rh^{106} (130 ± 2 MIN).

S.Mayo and S.J.Nassiff.

Phys. Rev., Vol. 111, No. 4, 1140-1 (Aug. 15, 1958).

The gamma-ray spectrum was studied with a NaI(Tl) crystal scintillation spectrometer of 9% resolution for the 662 keV gamma line of Cs^{137}. The following gamma rays — in keV — were obtained: 220 ± 5 (18%), 435 ± 5 (43%), 515 ± 5 (100%), 610 ± 5 (26%), 735 ± 5 (36%), 820 ± 5 (45%), 940 ± 10 (?), 1070 ± 5 (40%), 1225 ± 5 (23%), 1380 ± 10 (?), 1555 ± 5 (23%), 1760 ± 10 (7%), 1860 ± 10 (8%), 2090 ± 10 (1%), 2260 ± 10 (1%). The measured half-life was 130 ± 2 min.

539.166 : 539.14

2753. RADIATIONS OF Os^{185}. S.S.Malik and A.Mukerji.

Phys. Rev., Vol. 111, No. 5, 1291-7 (Sept. 1, 1958).

The radiations were examined in a thin magnetic lens beta-ray spectrometer and in coincident scintillation spectrometers. By these means, gamma rays of energies, 75, 122, 158, 233, 593, 643, 718, 750, 870, and 878 keV were observed, revealing excited energy levels of the residual nucleus, Re^{185}, at 122, 643, 718, 870, and 878 keV. Internal conversion coefficient measurement showed the 643 keV gamma ray to be predominantly E2. A search for positrons was made by observing gamma—gamma coincidences with the counters placed at 180° and 90°. An upper limit of $(4 \pm 3) \times 10^{6}$ positron per disintegration could be set.

539.166 : 539.14

2754. LEVELS OF Be^{10} AND B^{10}.

W.E.Meyerhof and L.F.Chase, Jr.

Phys. Rev., Vol. 111, No. 5, 1348-57 (Sept. 1, 1958).

The gamma-rays produced in the bombardment of Be^9 (thick target) with 2.8 MeV deuterons were measured with a three-crystal pair spectrometer. The gamma-rays are assigned in a consistent manner to decay from known levels of Be^{10} and B^{10}. Using information from stripping reactions it can then be inferred that the spins of 5.96 and 6.26 MeV levels of Be^{10} are 1^- and 2^+, respectively. Furthermore it is shown that the gamma-ray and stripping information is consistent with spins 2^- and 2^+ for the 5.11 and 5.16 MeV levels of B^{10}, respectively, and that the 5.16 MeV level of B^{10} must have a very small alpha-particle reduced width, in accordance with a proposal of Wilkinson and Jones. Reduced widths of many levels of Be^{10} and B^{10} are summarized and analogue levels in the two nuclei are searched for and compared.

539.166

2755. GAMMA-RAY DECAY IN Hg^{200}. R.E.Segel.

Phys. Rev., Vol. 111, No. 6, 1620-30 (Sept. 15, 1958).

Gamma—gamma cascades following thermal neutron capture in Hg^{109} were measured. A three-crystal pair spectrometer was used to measure the high-energy gamma rays and a single NaI(Tl) crystal spectrometer detected the lower energy radiation. A detailed comparison is made between the experiment reported here, the previously known high-resolution mercury capture gamma-ray spectrum, and the previously measured decay scheme of Tl^{200}. Several discrepancies between the capture gamma-ray and β-decay work are resolved, though others remain. By combining the results of the three experiments, probable spin and parity assignments are made for several of the low-lying levels in Hg^{200}. With these spin assignments, some conclusions are drawn as to the relative transition probabilities for the various multipolarity radiations present.

539.166

2756. DIRECTIONAL CORRELATION OF GAMMA RAYS IN Ge^{72}.

R.G.Arns and M.L.Wiedenbeck.

Phys. Rev., Vol. 112, No. 1, 229-31 (Oct. 1, 1958).

Directional correlation measurements were made on the 0.63-0.835 MeV, 2.20-0.835 MeV, 2.49 and 2.51-0.835 MeV and 1.88-1.46 MeV gamma—gamma cascades in Ge^{72} following beta decay of 14.2 hour Ga^{72}. The level at 0.835 MeV has a spin and parity assignment of 2+ and proceeds to the 0+ ground state by pure electric quadrupole radiation. The 0.63 MeV transition proceeds from a 2+ level at 1.46 MeV to the 0.835 MeV level by radiation which is largely electric quadrupole with a small magnetic dipole admixture. The correlation data are consistent with spin assignments of 2 or 3 for the levels at 3.04, 3.32 and 3.34 MeV.

539.166

2757. GAMMA RADIATION FROM Al^{27} + p AND F^{19} + p.

W.A.Ranken, T.W.Bonner, R.Castillo-Bahena, M.V.Harlow, Jr and T.A.Rabson.

Phys. Rev., Vol. 112, No. 1, 239-43 (Oct. 1, 1958).

Gamma radiations with energies less than 3 MeV were observed with an intermediate-image lens spectrometer when targets of aluminium and fluorine were bombarded by protons. Gamma-ray spectra from Al + p were obtained for proton energies of 2.4, 3.0, 4.0 and 4.4 MeV. Gamma radiation with quantum energies of 0.845, 1.014, 1.722, 2.216 and 2.992 MeV were observed and are attributed to excited states of Al^{27}. Gamma radiations of 1.369 MeV from Mg^{24} and 2.741 MeV, probably from both Al^{27} and Mg^{24}, were also observed. Internal conversion electrons from the excited states of Al^{27} were observed; the conversion coefficients indicate that the 0.845 MeV radiation is E2 and that the 1.014 MeV radiation is M1. Gamma radiation from F^{19} + p was observed with quantum energies of 1.236, 1.358 and 1.46 MeV. The relative intensities of the γ-rays were observed for proton energies of 3.22, 3.65 and 4.27 MeV.

539.166

2758. PRECISION DETERMINATION OF GAMMA RAYS FOLLOWING (p,p'γ) AND (p,nγ) REACTIONS.

E.L.Chupp, J.W.M.DuMond, F.J.Gordon, R.C.Jopson and H.Mark.

Phys. Rev., Vol. 112, No. 2, 532-5 (Oct. 15, 1958).

The gamma-rays following (p,p'γ) or (p,nγ) reactions in seven isotopes were studied with a bent quartz-crystal spectrograph. The intense gamma-ray sources necessary for such experiments were provided by bombarding various target materials with large proton-beam currents from the A-48 accelerator. The following reactions and associated gamma-rays were observed: $F^{19}(p,p'\gamma)$, 109.87 ± ± 0.04 keV, $Ti^{48}(p,n\gamma)V^{49}$, 90.65 ± 0.02, 62.29 ± 0.01 keV; $Mn^{55}(p,p'\gamma)$, 125.87 ± 0.05 keV; $Ni^{61}(p,p'\gamma)$, 67.40 ± 0.01 keV; $Cu^{65}(p,n\gamma)Zn^{65}$, 53.93 ± 0.01, 61.20 ± 0.01, 115.09 ± 0.04 keV; $Ge^{73}(p,p'\gamma)$ 67.03 ± ± 0.01 keV, and $Se^{80}(p,n\gamma)Br^{80}$ 37.05 ± 0.01 keV.

539.166

2759. RADIATIONS OF Xe^{127}. R.N.Forrest and H.T.Easterday.

Phys. Rev., Vol. 112, No. 3, 950-4 (Nov. 1, 1958).

The energies of previously observed gamma-rays were found to be 58 ± 1, 146 ± 0.5, 173.0 ± 0.5, 204.5 ± 0.5, and 377.5 ± 0.5 keV. Conversion electron intensities relative to gamma-ray intensities and internal conversion coefficients were measured. The experiment indicates that electron capture to the ground state is suppressed. Spin and parity assignments are proposed for the 204 and 377 keV excited states of I^{127}.

539.166

2760. DECAY OF Cu^{62}. J.W.Butler and C.R.Gossett.

Phys. Rev., Vol. 112, No. 4, 1257-63 (Nov. 15, 1958).

A source of Cu^{62} was prepared by means of the (p,γ) reaction on an enriched Ni^{61} target. The gamma-rays following positron emission were detected with a scintillation spectrometer, and the following energies were measured: 0.88 ± 0.01, 1.13 ± 0.02 and 1.17 ± 0.01 MeV. The relative intensities with respect to the positrons are 0.3, 0.1 and 0.5% with uncertainties of a factor of two either way. Coincidence techniques and half-life measurements were used to identify the gamma-rays with the decay of Cu^{62}. The half-life for positron emission was measured to be 9.9 ± 0.2 min. Branching ratios and log ft values have been calculated and are listed in tabular form.

539.166 : 539.17

2761. γ-EMISSION IN RADIATIVE CAPTURE OF THERMAL NEUTRONS BY Mo^{95}, Ag^{107}, Te^{123} AND Cs^{133} NUCLEI.

L.F.Kalinkin, A.S.Melioranskiĭ and I.V.Éstulin.

Zh. eksper. teor. Fiz., Vol. 35, No. 3(9), 592-8 (1958). In Russian.

A single-crystal scintillation spectrometer adjusted for work at high counting rates was employed in the energy range from 20 to 1000 keV for measurement of the energy and absolute intensities of γ-rays emitted during radiative capture of neutrons by samples enriched with isotopes of Mo^{95}, Ag^{107}, Te^{123} and also Cs^{133}. The γ-rays detected are due to transitions between the lower excited states of the investigated nuclei.

539.166.07

2762. RESPONSE OF "TOTAL ABSORPTION" SPECTROMETERS TO GAMMA RAYS.

R.C.Davis, P.R.Bell, G.G.Kelley and N.H.Lazar.

I.R.E. Trans Nuclear Sci., Vol. NS-3, No. 4, 82-6 (Nov., 1956).

A single crystal of sodium iodide $9\frac{1}{4}$ in. in diameter and 9 in. high with the top bevelled at 45° was obtained, and a half-inch hole was drilled in the bevelled end to the centre of the crystal. Three 5 in. diameter Dumont 6364 phototubes were optically connected directly to the flat end of the crystal. Sources were placed inside the crystal and γ-spectra obtained, taking advantage of full geometry. A $4\frac{3}{4}$ in. diameter sodium iodide crystal $5\frac{1}{2}$ in. high with the top bevelled at 45° had a $\frac{1}{4}$ in. hole drilled to the centre. The crystal was optically connected to a Dumont 6364. The crystal is placed inside a 28 in. tank of liquid scintillator which uses four Dumont 6364 phototubes to detect pulses in the liquid. Samples were placed inside the crystal and the pulses from the crystal and liquid scintillator were placed in anticoincidence to reduce the Compton portion of the γ-spectra. Typical spectra with these counters are shown along with a comparison of data taken with these and smaller crystals.

539.166.08

2763. LOW ENERGY GAMMA SCINTILLATION SPECTROMETRY.

C.J.Borkowski.

I.R.E. Trans Nuclear Sci., Vol. NS-3, No. 4, 71-6 (Nov., 1956).

Techniques are reviewed which are used: to obtain good resolution with scintillation spectrometers; to minimize pulses which fall outside of photo-peaks; to measure absolute gamma efficiencies of NaI crystals as a function of energy; and to measure K/L capture ratios and gamma conversion coefficients. Some factors affecting energy resolution including associated electronic circuits are discussed.

539.166.2 : 539.17

2764. GAMMA-RAYS FROM INELASTIC NEUTRON SCATTERING IN Na^{23}. J.M.Freeman and J.H.Montague.

Nuclear Phys., Vol. 9, No. 2, 181-97 (Dec. [1], 1958).

Gamma-rays following inelastic neutron scattering in Na^{23} were measured with neutron bombarding energies up to 3.7 MeV, and the modes of decay of the first six excited states have been investigated. Transitions to the ground state and to the first excited state at 0.44 MeV were observed with a ring geometry arrangement, and the cascade transitions were confirmed by $\gamma-\gamma$ coincidence measurements. Where possible, estimates were made of the ratio of the intensities of emission from a particular level to the ground state and to the first excited state. The following gamma-rays were observed (an asterisk indicates a transition to the first excited state 0.438 MeV from the first excited state; 2.088 and 1.643* MeV from the second excited state (intensity ratio 0.19); 2.386 and 1.954* MeV from the third excited state (intensity ratio 3.0); 2.635 MeV from the fourth and 2.27* MeV from the fifth excited state; 2.979 and 2.56* MeV from the sixth excited state (intensity ratio of the order unity). Cross-section curves for excitation of the levels at 0.44, 2.08 and 2.39 MeV were also measured.

539.166.2 : 539.17

2765. VARIATIONS IN SPECTRA OF RESONANCE NEUTRON CAPTURE GAMMA RAYS IN INDIUM.

J.E.Draper, C.A.Fenstermacher and H.L.Schultz.

Phys. Rev., Vol. 111, No. 3, 906-12 (Aug. 1, 1958).

Measurements are reported of the 0-350 keV portion of the gamma-ray spectra following neutron capture in the 1.46, 3.86, and 9.10 eV resonances of the In^{115} target nucleus. The prominent features of the spectra are significantly different for the three resonances as indicated by the ratios of relative intensities of the 67, 98, 188, and 280 keV gamma-rays. The 0-1600 keV portion of the spectrum following thermal neutron capture is presented. The absolute intensity of the 280 keV gamma-ray was measured for the three resonances.

539.166.2

2766. STUDIES OF DECAY SCHEMES IN THE OSMIUM-IRIDIUM REGION. I. ISOMERS Os^{190m} (10 MIN) AND Os^{189m} (5.7 HR).

G.Scharff-Goldhaber, D.E.Alburger, G.Harbottle and M.McKeown.

Phys. Rev., Vol. 111, No. 3, 913-19 (Aug. 1, 1958).

While the decay-scheme of the even-even isomer Os^{190m}(10 min) has some similarity with that of the "rotational" isomer Hf^{180m}, it differs from the latter in that Os^{190} lies in the transition region between the nuclei with rotational and those with near-harmonic level schemes. It was previously believed that the lifetime determining transition in Os^{190m} was a 620 keV transition followed by three lower energy gamma-rays. The authors find, however, that the isomeric transition is a previously overlooked 38.4 keV M2 transition with an $|M|^2 = 2.6 \times 10^{-9}$ ("K-forbidden"). It is followed by four successive γ-rays. Internal-conversion electron studies by means of an intermediate-image spectrometer yielded γ-ray energie of 187 ± 1 keV, 359 ± 2 keV, 500 ± 3 keV, and 614 ± 3 keV. All four transitions are of electric quadrupole character, suggesting that the levels populated are 8+, 6+, 4+, 2+, 0+ (ground state). Delayed coincidence measurements by Sunyar show that the two lowest energy transitions of 359 and 187 keV take place between the levels 4+ → 2+ and 2+ → 0+ respectively and it may be expected that also the two higher energy γ-rays follow each other in the order of decreasing energy. However, in contrast to the level spacings in true rotational nuclei, the level energies are far from being proportional to I(I + 1), and cannot even be represented with the help of a correction term $\sim I^2(I + 1)^2$. The six-hour osmium isomer, which was discovered by T.C.Chu and assigned by him to Os^{190m}, was identified instead as Os^{189m}. The half-life was found to be 5.7 ± 0.1 hr. The isomer decays by a 30.0 keV M3 transition to the ground state with $|M|^2 = 2.2 \times 10^{-5}$.

539.166.2

2767. DECAY OF Ag^{110m}. E.G.Funk, Jr and M.L.Wiedenbeck.

Phyd. Rev., Vol. 112, No. 4, 1247-51 (Nov. 15, 1958).

The gamma-rays from Ag^{110m} were studied in magnetic spectrometers. Twenty-two electron lines corresponding to 14 gamma transitions were observed. These gamma-rays were arranged in a plausible decay scheme. Directional correlation measurements were carried out on six gamma cascades in Cd^{110} resulting in spin assignments for 4 levels and multipolarity assignments for the strong gamma transitions.

539.166.83

2768. ON THE INTERNAL CONVERSION OF THE E3-TRANSITION IN ^{107}Ag.

H.Schneider, I.J.van Heerden and D.Reitmann.

Nuovo Cimento, Vol. 10, No. 2, 338-41 (Oct. 16, 1958).

Measurements of the relative internal conversion coefficients of the 93.9 keV transition in Ag^{107} are described. The $L_{I} : L_{II} : L_{III}$ and K : L ratios presented are in excellent agreement with the theoretical values obtained from the tables of Rose. The K : M ratio, however, is inconsistent; this is ascribed to the screening effect not being taken into account in the calculations.

539.166.83

2769. EFFECT OF FINITE NUCLEAR DIMENSIONS ON THE RELATIVE INTERNAL CONVERSION COEFFICIENTS IN L-SUBSHELLS.
A.G.Sergeev, V.D.Vorob'ev, A.S.Remennyĭ, T.I.Kol'chinskaya, G.D.Latyshev and Yu.S.Egorov.
Zh. eksper. teor. Fiz., Vol. 35, No. 2(8), 348-54 (1958). In Russian.

The relative conversion coefficients in L-subshells were measured for three pure M1-transitions: 46.5 keV in Bi^{210} and 115.1 and 238.6 keV in Bi^{212}. It is shown that in order to obtain agreement between the experimental data and theoretical calculations of the L-conversion coefficients the finite dimensions of the nucleus should be taken into account. The ratios L_I:L_{II}:L_{III} for the M1-transitions of 277.3 keV in Pb^{208} were also measured.

539.166.83 : 539.165

2770. POLARIZATION OF INTERNAL CONVERSION ELECTRONS EMITTED AFTER β-DECAY. V.B.Berestetskiĭ and A.P.Rudik.
Zh. eksper. teor. Fiz., Vol. 35, No. 1(7), 159-64 (1958). In Russian.

The correlation between the polarization of conversion electrons and the direction of electrons emitted in the preceding β-decay is considered. If the Coulomb field of the nucleus is neglected one finds in the case of a magnetic multipole that the polarization is longitudinal and is independent of the energy. In the case of an electric multipole, longitudinal as well as transverse polarizations exist which are dependent on the energy. [English version in: Nuovo Cimento, Vol. 10, No. 2, 375-82 (Oct. 16, 1958).]

539.166.83 : 539.165

2771. POLARIZATION OF INTERNAL-CONVERSION ELECTRONS EMITTED AFTER β-DECAY. B.V.Geshkenbeĭn.
Zh. eksper. teor. Fiz., Vol. 35, No. 5(11), 1235-42 (1958). In Russian.

The correlation between the polarization of conversion electrons and the direction of electron emission in the preceding β-decay is considered. The whole calculation is conducted with allowance for the nuclear electric field. Conversion can occur in any of the shells. The nuclear electric field exerts a considerable effect, leading to the appearance of an appreciable transverse polarization component in magnetic transitions and to a significant increase of the polarization in electric transitions, on electrons converted in the K-shell. [English version in: Nuovo Cimento, Vol. 10, No. 2, 365-74 (Oct. 16, 1958).]

NUCLEAR REACTIONS

539.17 : 539.165

2772. BERYLLIUM-7 EXTREME HIGH TEMPERATURE EXPERIMENT. C.A.Accardo.
Phys. Rev. Letters, Vol. 1, No. 5, 180-1 (Sept. 1, 1958).

Decay of Be^7 by K-capture cannot occur if the atoms are completely ionized, e.g. by putting a sample in a sufficiently high temperature plasma. R.S.Pease

539.17

2773. DETERMINATION OF THE ENERGY OF FAST PARTICLES FROM THE ANGULAR DISTRIBUTION OF THE REACTION PRODUCTS. A.I.Nikishov and I.L.Rozental'.
Zh. eksper. teor. Fiz., Vol. 35, No. 1(7), 165-9 (1958). In Russian.

The error appearing in energy E determinations of fast colliding particles from the angular distribution of the produced particles is analysed. It is found that in order to determine the energy by this method one should take into account the relation between the total number of observed star tracks and the energy E. The dependence predicted by the Landau theory is employed in the present work. An approximate distribution of E as a function of the angles and number observed tracks is obtained.

539.17

2774. ENERGY DEPENDENCE OF THE CROSS-SECTIONS FOR MULTIPLE PRODUCTION REACTIONS NEAR THRESHOLD.
A.F.Grashin.
Zh. eksper. teor. Fiz., Vol. 35, No. 3(9), 719-25 (1958). In Russian.

Threshold energy dependence of the cross-section for the multiple creation of particles was derived taking into account the Pauli principle and Coulomb interaction between the emitted particles and the residual nucleus. In the general case, recoil of the nuclei and Coulomb interaction between the emitted particles were neglected. When not more than one of the emitted particles was charged, nuclear recoil was taken into account and the formulae thus obtained are exact ones.

539.17 : 539.12

2775. HYDRODYNAMIC THEORY OF MULTIPLE PRODUCTION OF PARTICLES IN COLLISIONS BETWEEN FAST NUCLEONS AND NUCLEI. G.A.Milekhin.
Zh. eksper. teor. Fiz., Vol. 35, No. 5(11), 1185-97 (1958).
In Russian.

The three-dimensional problem of divergence of the particles emitted in the collision between a nucleon and nucleus was solved by a method which differs from that used by Landau (1953) and Amai et al. (1957) and is more precise. The distributions in energy, angle and transverse momenta are investigated with the aid of the solution obtained. The error in the final formulae is ~ 20%.

539.17 : 539.12

MULTIPLE PRODUCTION OF PARTICLES. See Abstr. 2561

539.17

2776. ACTIVATION CROSS SECTIONS FOR $C^{12}(p,pn)C^{11}$, $O^{16}(p,\alpha)N^{13}$, AND $F^{19}(p,pn)F^{18}$. A.B.Whitehead and J.S.Foster.
Canad. J. Phys., Vol. 36, No. 10, 1276-85 (Oct., 1958).

Studied in the region from threshold over a range of about 10 MeV proton energy. The scattering and 180° focusing technique for proton irradiation was employed to realise improved energy resolution. The reaction $U^{16}(p,\alpha)N^{13}$ exhibited three large peaks at proton energies of 8.6, 11.3 and 14.6 MeV in the laboratory system. The maximum cross-sections were 46, 55 and 45 millibarns respectively. Though not so pronounced as in the oxygen case, minor peaks in the cross-section for $C^{12}(p,pn)C^{11}+C^{12}(p,d)C^{11}$ modulated the previously smooth curve. These occurred at energies of 19.8, 20.9 and 22.2 MeV. The known excitation function for this reaction was extended from 32 to 42 MeV and proved to be flat, thereby clarifying the normalization between the higher- and lower-energy regions. The irradiation of F^{19} with protons to produce F^{18} yielded a cross-section which was a smooth function of energy, and thus differed in shape from the corresponding carbon curve.

539.17

2777. ENERGETIC HEAVY FRAGMENTS EMITTED FROM NUCLEAR STARS. S.Nakagawa, E.Tamai and S.Nomoto.
Nuovo Cimento, Vol. 9, No. 5, 780-90 (Sept. 1, 1958).

The authors have investigated the heavy nuclear fragments ($Z \geq 3$) emitted in cosmic-ray stars of heavy nuclei (Ag, Br) in emulsion by the method of charge determination, by measuring their track width. It was found that a majority of the fragments were ejected by the nuclear evaporation process, but that also there was a small number of the energetic fragments ($Z \geq 3$) not explained by this process. The energetic ones emitted in the stars (due to Ag or Br nuclei) induced by 6.2 GeV protons from a bevatron are described. The charge distribution, angular distribution, and energy spectra of those particles were determined. The angular distribution shows strong collimation in the direction of the primary, and significantly differs from that of the evaporated (slow) fragments. The charge distribution gives an exponential decrease with increase in the charge and is similar in form to that of the evaporation process. It seems that the energetic fragments may not be produced by the evaporation process nor by the direct knock-on processes by the primary. It is probable that they may be ejected as the result of intense local heating near the surface of the nucleus during the process of nuclear cascade.

539.17

2778. NEUTRONS FROM THE p + d BREAKUP REACTION.
W.Heckrotte and M.MacGregor.
Phys. Rev., Vol. 111, No. 2, 593-6 (July 15, 1958).

The high-energy end of the energy spectrum of neutrons from the p + d reaction at incident energies of about 10 MeV is examined. It is found that the structure in the spectrum measured by Nakada and co-workers can be attributed to the final-state interaction of the two protons.

539.17

2779. GAMMA RAYS FROM THE PROTON BOMBARDMENT OF Mg^{24}. H.E.Gove, A.E.Litherland, E.Almqvist and D.A.Bromley.
Phys. Rev., Vol. 111, No. 2, 608-15 (July 15, 1958).

Further measurements on the $Mg^{24}(p,\gamma)Al^{25}$ reaction at the 1.66 MeV resonance have revealed a new level in Al^{25} at an excitation energy of 2.739 ± 0.010 MeV. The level decays to the ground state, the second excited state at 0.95 MeV, and the fourth excited state at 1.81 MeV in the intensity ratios (8 ± 6):(63 ± 10):(29 ± 14). This new level should correspond to a resonance at 0.47 MeV in the laboratory system. A careful search for the resonance failed to show it and an upper limit on its value of $\omega(\Gamma_p\Gamma_\gamma/\Gamma)$ is 0.6×10^{-3} eV.

Revised gamma-ray branching ratios for the decay of the level corresponding to the 1.66 MeV resonance have been established. The excitation energies of the first and second excited states in Al^{25} have been measured as 0.461 ± 0.004 and 0.949 ± 0.003 MeV, respectively. The Q value for the $Mg^{24}(p,\gamma)Al^{25}$ reaction is found to be 2.287 ± 0.006 MeV. The existence of the previously reported level at 1.61 MeV in Al^{25} is confirmed as is the fact that the proton width of the 0.418 MeV resonance in the $Mg^{24}(p,\gamma)$ reaction is substantially greater than the gamma-ray width.

539.17

2780. $C^{12}(p,pn)C^{11}$ CROSS SECTION AT 2 AND 3 BeV.
J.B.Cumming, G.Friedlander and C.E.Swartz.
Phys. Rev., Vol. 111, No. 5, 1386-94 (Sept. 1, 1958).

Absolute measurements were carried out in the external pencil beam of the Cosmotron at 2 and 3 BeV. The proton flux was measured with a counter telescope, and the C^{11} activity induced in 1 in. thick plastic scintillators was determined by internal scintillation counting. Corrections for the formation of C^{11} by secondary particles produced in the thick targets were determined in separate experiments in which thin- and thick-target cross-sections were compared directly. Other corrections for scattering and absorption effects and for deadtime losses in counters are discussed. Measurements were carried out both at proton fluxes sufficiently low to permit direct counting with the primary telescope and at higher fluxes which required scaling procedures with secondary telescopes. The measured cross-sections for the $C^{12}(p,pn)C^{11}$ reaction are 26.0 ± 0.9 and 26.6 ± 1.0 millibarns at 2.0 and 3.0 BeV, respectively. From these data and from previously published cross-section ratios, the cross-section of the $Al^{27}(p,3pn)Na^{24}$ reaction is found to be 10.4 ± 0.6 and 10.0 ± 0.6 millibarns at 2.0 and 3.0 BeV, respectively.

539.17

2781. RADIATIVE CAPTURE OF PROTONS IN OXYGEN AT 140 TO 170 keV. R.E.Hester, R.E.Pixley and W.A.S.Lamb.
Phys. Rev., Vol. 111, No. 6, 1604-6 (Sept. 15, 1958).

The thick-target yield of the reaction $O^{16}(p,\gamma)F^{17}$ was measured by bombarding Al_2O_3 targets with protons from 140 to 170 keV using currents from 3 to 10 mA and counting the induced positron activity of the F^{17}. The thick-target yield ranges from $(1.9 \pm 1) \times 10^{-17}$ beta/incident-proton at 140 keV to $(1.47 \pm 0.15) \times 10^{-16}$ beta/incident-proton at 170 keV. The corresponding cross-sections are $(4.6 \pm 2.4) \times 10^{-11}$ barn at 140 keV and $(2.34 \pm 0.3) \times 10^{-10}$ barn at 170 keV. The activity was identified by observing the half-life. The cross-section factor S_0 was found to be 6.8 ± 1.4 keV barns between 140 keV and 170 keV bombarding energy.

539.17

2782. DOUBLE SCATTERING EXPERIMENTS WITH 970 MeV PROTONS. C.J.Batty and S.J.Goldsack.
Proc. Phys. Soc., Vol. 72, Pt 6, 1130-6 (Dec., 1958).

Nuclear emulsions were used as detectors to measure the asymmetries produced in a double scattering experiment using 970 MeV protons. Targets of beryllium and carbon were used and angles between 3° and 8° investigated. Small but significant asymmetries were found and the experiments are compared with others in this energy region.

539.17 : 539.12

2783. OPTICAL MODEL ANALYSIS OF THE SCATTERING OF 310 MeV PROTONS BY CARBON. C.J.Batty.
Proc. Phys. Soc., Vol. 73, Pt 2, 185-92 (Feb., 1958).

The optical-model parameters for the scattering of 310 MeV protons by carbon are obtained in an analysis using the semi-classical approximation. The results are compared with those obtained by other analyses in this energy region. The modification of the Coulomb scattering by the absorption of protons in the nucleus is also considered in some detail.

539.17 : 539.12

2784. SMALL ANGLE SCATTERING OF 970 MeV PROTONS FROM CARBON. C.J.Batty, P.J.Duke, S.J.Goldsack and W.O.Lock.
Nuovo Cimento Suppl., Vol. 9, No. 2, 369-71 (1958).

Results of a preliminary experiment. For final details see following abstract.
C.J.Batty

539.17 : 539.12

2785. THE SMALL ANGLE SCATTERING OF 970 MeV PROTONS BY CARBON. C.J.Batty, W.O.Lock and P.V.March.
Proc. Phys. Soc., Vol. 73, Pt 1, 100-9 (Jan., 1959).

The differential cross-section for the scattering of 970 MeV protons by carbon through laboratory angles of $1\frac{1}{2}^{\circ}$ to 5° was measured using nuclear emulsions to detect the scattered particles. The results show a sharp rise at small angles due to the onset of Coulomb scattering and were fitted at the larger angles (greater than 2°) in terms of a simple model in which the nucleus is represented by a purely imaginary central potential. Values for the diffraction and total cross-sections are then derived. Preliminary results of a more detailed analysis, which includes a spin—orbit potential, shows that a fit can be obtained at all angles if a small negative real part to the central potential is included. Further evidence is found for polarization effects at these energies.

539.17 : 537.54

2786. NEUTRON THRESHOLD MEASUREMENTS USING THE CHALK RIVER TANDEM VAN DE GRAAFF ACCELERATOR.
H.E.Gove, J.A.Kuehner, A.E.Litherland, E.Almqvist, D.A.Bromley, A.J.Ferguson, P.H.Rose, R.P.Bastide, N.Brooks and R.J.Connor.
Phys. Rev. Letters, Vol. 1, No. 7, No. 7, 251-3 (Oct. 1, 1958).

Beams of energy up to 10.5 MeV and intensity of 0.5 μA or greater were used to determine the neutron thresholds of P^{31}, Ni^{58} and Ni^{60}. Values of 6.50 ± 0.10 MeV, 9.459 ± 0.070 and 7.028 ± 0.020 respectively were obtained. The 90° deflector magnet, used to measure the proton momenta, was calibrated in the lower ranges by observing the known $B^{11}(p,n)$, $Na^{23}(p,n)$ and $Al^{27}(p,n)$ thresholds, and in the higher momentum range by deflecting quadruply and quintuply ionized O^{16} atoms to measure the $H^2(O^{16},n)F^{17}$ threshold which was computed as 14.750 ± 0.024 MeV from the known $O^{16}(d,n)F^{17}$ threshold at 1.836 ± 0.003 MeV.
A.E.I. Research Laboratory

539.17

2787. SECONDARY NUCLEAR REACTIONS IN BISMUTH AND LEAD INDUCED BY HIGH-ENERGY PROTON BOMBARDMENT.
B.V.Kurchatov, V.N.Mekhedov, L.V.Chistyakov, M.Ya.Kuznetsova, N.I.Borisova and V.G.Solov'ev.
Zh. eksper. teor. Fiz., Vol. 35, No. 1(7), 56-63 (1958). In Russian.

The production of astatine isotopes (Z = 85) by bombardment of bismuth (Z = 83) and lead (Z = 82) with protons of energies up to 480 MeV was studied by a radiochemical method. The cross-sections for At^{211} and At^{210} production on bismuth were found to equal 6×10^{-29} and 2×10^{-29} cm^2 respectively. The formation of light isotopes, At^{205} and At^{203} was established. At^{211} was detected in lead ($\sigma \sim 10^{-31}$ cm^2). The phenomena observed are explained by assuming them to be the result of secondary reactions of capture of the disintegration products (α-particles or lithium nuclei). Formation of light astatine isotopes is explained by high-energy proton capture with subsequent emission of π^--mesons and several neutrons. The cross-section for production of α-particles with $E > 20$ MeV from bismuth irradiated by 480 MeV protons was determined from the astatine yield and found to be $5-6 \times 10^{-25}$ cm^2.

539.17 : 539.12

2788. INVESTIGATION OF THE $p + p \rightarrow d + \pi^+$ REACTION IN A BEAM OF POLARIZED PROTONS.
Yu.K.Akimov, O.V.Savchenko and L.M.Soroko.
Zh. eksper. teor. Fiz., Vol. 35. No. 1(7), 89-96 (1958). In Russian.

The angular dependence of the asymmetry of π^+-mesons emitted in the $p + p \rightarrow d + \pi^+$ reaction was measured on a polarized beam of 536, 616 and 654 MeV protons. A direct proof of the existence of a d-state of the mesons in the $p + p \rightarrow \pi^+ + d$ reaction was obtained. The results of the experiment are consistent with the assumption that the amplitudes of the s- and d-transitions are much smaller than that of the ${}^1D_2 \rightarrow {}^3S_1p_2$ transition. Limiting estimates of the values of some of the partial cross-sections are presented.

539.17

2789. FORMATION OF TRITIUM IN METALS BY 120-660 MeV PROTONS. V.V.Kuznetsov and V.N.Mekhedov.
Zh. eksper. teor. Fiz., Vol. 35, No. 3(9), 587-91 (1958). In Russian.

Results of investigation of the formation of tritium in various elements induced by 660 MeV protons are presented. The excitation functions are given for tritium formation in aluminium and lead in the 120-660 MeV energy range.

539.17

2790. A RADIOCHEMICAL STUDY OF THE (p,pxn), (p,4pxn) AND (p,5pxn) REACTIONS. T.V.Malÿsheva and I.P.Alimarin.
Zh. eksper. teor. Fiz., Vol. 35, No. 5(11), 1103-12 (1958). In Russian.

A radiochemical investigation of the bismuth, mercury and gold nuclides, produced in the disintegration of bismuth by 660 MeV protons carried out. A method for quantitative determination of radionuclides based on L-radiation is proposed for isotopes which have undergone elementary capture. The half-period of Hg^{193}, which is 4 hours, and E-capture in the gold isomer Au^{193m} were determined by successive extraction of the daughter fractions. On the basis of the dependence of the yields of the reactions (p,pxn), (p,4pxn) and (p,5pxn) on the number of emitted neutrons some conclusions regarding the mechanism of disintegration of complex nuclei by high-energy protons are drawn.

539.17 : 537.591.8

INELASTIC INTERACTION OF COSMIC-RAY PROTONS OF KINETIC ENERGIES ABOVE 7 BeV WITH CARBON AND HYDROGEN NUCLEI. See Abstr. 2478

539.17 : 539.12

ABSORPTION CROSS SECTIONS OF CARBON, IRON AND LEAD FOR 1.5 GeV NEGATIVE PIONS AND 2.8 GeV PROTONS. See Abstr. 2632

539.17 : 539.12

π^+-MESONS PRODUCED IN P—P COLLISIONS AT 660-670 MeV. See Abstr. 2637

539.17 : 539.14

STUDY OF $Si^{30}(p,\gamma)P^{31}$ AND EXCITED STATES OF P^{31}. See Abstr. 2701

539.17 : 539.12

2791. TIME DEPENDENT THEORY OF SCATTERING OF NUCLEONS BY NUCLEI. F.Coester and H.Kümmel.
Nuclear Phys., Vol. 9, No. 2, 225-36 (Dec. [1], 1958).

The optical model for the scattering of nucleons by nuclei is derived from the general time-dependent scattering theory. The exclusion principle is taken into account without approximations. A suitably defined single-particle wave-function is shown to satisfy a "Schrödinger-equation" with a non-Hermitian "optical potential" defined by an integral equation in terms of the two body interaction. Solutions of this integral equation are not discussed. Thus the derivation of the model as such is separated from the approximations needed for its application to concrete problems. If the exclusion principle is taken into account the wave-functions of the optical model are probability amplitudes only asymptotically for $t \to \pm\infty$. This asymptotic property is sufficient for the calculation of S-matrix elements and cross-sections.

539.17

2792. DEUTERON STRIPPING ON SPHEROIDAL NUCLEI. I. J.Sawicki.
Bull. Acad. Polon. Sci. Ser. Sci. math. astron. phys., Vol. 6, No. 1, 37-44 (1958).

Considers the extension of deuteron stripping theory to deformed nuclei containing 8-20 neutrons and protons. The nuclei are described by a spheroidal harmonic oscillator well, in the manner of Nilsson. The experimental cross-sections for the (d,p) reaction in Al^{27} are fitted. J.M.Cassels

539.17

2793. DEUTERON STRIPPING ON SPHEROIDAL NUCLEI. II. J.Sawicki.
Bull. Acad. Polon. Sci. Ser. Sci. math. astron. phys., Vol. 6, No. 1, 45-9 (1958).

Discusses the angular correlation of the γ-rays, following stripping by deformed nuclei. J.M.Cassels

539.17

2794. THE REACTION $F^{19}(d,n)Ne^{20}$ AND THE ENERGY LEVELS OF Ne^{20}. S.Morita and K.Takeshita.
J. Phys. Soc. Japan, Vol. 13, No. 11, 1241-7 (Nov., 1958).

The energy spectra of neutrons emitted in the reaction $F^{19}(d,n)Ne^{20}$, produced by the 2.17 MeV deuteron, were measured with nuclear plates disposed at angles of from 0° to 165°, with respect to the incident deuteron, at intervals of 15°. The general features of the spectra were consistent with the evaporation model. From these spectra, the energy levels of Ne^{20} were found at excitation energies of 1.74 ± 0.03, 4.20 ± 0.04, 4.96 ± 0.05, 5.62 ± 0.04, 6.80 ± 0.01, 7.16 ± 0.09, 7.41 ± 0.05, 7.90 ± 0.04, 9.15 ± 0.04 and 10.01 ± 0.03 MeV. Some evidences for the existence of new levels at 0.65 ± 0.04, 2.53 ± 0.07, 8.32 ± 0.03, 8.71 ± 0.01 and 9.50 ± 0.04 MeV were also obtained. The Q-value for the ground state transition was determined to be 10.81 ± 0.03 MeV. The angular distributions of the neutrons leading to the ground state and the lowest four excited states, with exception of the uncertain states, were obtained and compared with the stripping theory. The agreement is not very good. The relative values of total cross-sections for each neutron group were estimated.

539.17

2795. PROTON ANGULAR DISTRIBUTIONS FROM $Cr^{52,53}(d,p)$ REACTIONS. A.J.Elwyn and F.B.Shull.
Phys. Rev., Vol. 111, No. 3, 925-8 (Aug. 1, 1958).

Targets enriched in Cr^{52} and Cr^{53} were bombarded with 10 MeV deuterons. Angular distributions were measured and Q-values determined for four proton groups from $Cr^{52}(d,p)Cr^{53}$ and for six groups from $Cr^{53}(d,p)Cr^{54}$. For the former reaction the Q-values were 5.74, 5.17, 4.77, and 3.43 MeV. For the latter the Q-values were 7.55, 6.69, 6.24, 4.88, 4.36, and 3.76 MeV. All angular distributions were of type $l_n = 1$ except for Q = 4.77 MeV in $Cr^{52}(d,p)$, for which $l_n = 3$. The latter group is interpreted as possibly a single-particle $f_{5/2}$ state, and these data may therefore reveal the relative position of single-particle $f_{5/2}$ and $p_{3/2}$ levels.

539.17

2796. PROTON—GAMMA RAY ANGULAR CORRELATIONS IN THE $Si^{28}(d,p\gamma)Si^{29}$ REACTION. H.A.Hill and J.M.Blair.
Phys. Rev., Vol. 111, No. 4, 1142-7 (Aug. 15, 1958).

The reaction was studied by measuring angular distributions of the protons leaving Si^{29} in its first and second excited states and by measuring the correlation between the protons of each group and the gamma rays emitted from the corresponding level. The angular distributions of proton groups p_1 and p_2 exhibit large peaks in the backward direction, indicating that heavy-particle stripping may be important. The (p_1,γ) correlations were found to be isotropic to ±6%. This is substantially different from the correlation which has been observed at a higher deuteron energy. The (p_2,γ) correlations are consistent with a $\frac{5}{2}+$ level in Si^{29} at 2.03 MeV. One (p_2,γ) correlation shows a 20% anisotropy in the plane perpendicular to the direction taken by the recoil nucleus, while another (p_2,γ) correlation is essentially isotropic.

539.17

2797. INVESTIGATION OF $D(d,n)He^3$ NEUTRONS AT 8.4 MeV W.W.Daehnick and J.M.Fowler.
Phys. Rev., Vol. 111, No. 5, 1309-13 (Sept. 1, 1958).

The angular distribution of neutrons from the reaction was obtained at 8.4 ± 0.1 MeV incident deuteron energy for centre-of-mass angles 2° to 84°. A single plastic crystal was used as a detector and deuterium gas at 200 lb/in.² as a target. The distribution is fitted by a sum of Legendre polynomials. It is also compared with the predictions of nuclear stripping theory, and adequate agreement is found with an angular distribution of the form

$$d\sigma/d\Omega \propto h_d{}^2 - \tfrac{2}{3}h_d h_{d'} + h_{d'}{}^2,$$

where the h_d and $h_{d'}$ represent the simple Butler stripping distributions for the incident and target deuterons, respectively. The interaction radius necessary was $R_0 = 7 \times 10^{-13}$ cm.

539.17

2798. EXTRAPOLATION PROCEDURE FOR THE LOW-ENERGY DEUTERON—DEUTERON REACTION CROSS SECTION. J.G.Brennan.
Phys. Rev., Vol. 111, No. 6, 1592-6 (Sept. 15, 1958).

A semiempirical study is made of the deuteron—deuteron reaction cross-section to determine its energy dependence at low energy and to permit more reliable extrapolation to energies below the experimental range. An energy-dependent correction to the simple W.K.B. form is shown to be indicated by experimental data. The energy-independent normalization factor is then determined by comparison with the experimental data over the range of ten to one hundred keV bombarding energy. This provides a cross-section formula which is more suitable for extrapolation to the region around one keV.

539.17

2799. POLARIZATION OF PROTONS FROM $C^{12}(d,p)C^{13}$ REACTION WITH DEUTERONS OF 1060 keV. M.K.Jurić and S.D.Ćirilov.
Phys. Rev., Vol. 112, No. 4, 1124-6 (Nov. 15, 1958).

The polarization was measured for a deuteron energy of 1060 keV at angles 20° and 140°. Elastic scattering by carbon was used to analyse the polarization. Nuclear emulsions were used as the proton detector. The observed magnitude of the polarization was found to be P = 54.3 ± 9.5% at 20° and P = 29.4 ± 12.6% at 140°. Positive sign of the polarization corresponds to the vector product $K_p \times K_d$.

539.17

2800. MEASUREMENT OF POLARIZATIONS IN STRIPPING REACTIONS. B.Hird, J.A.Cookson and M.S.Bokhari.
Proc. Phys. Soc., Vol. 72, Pt 4, 489-93 (Oct., 1958).

The polarization of the protons from the reaction $C^{12}(d,p)C^{13}$ at 6.9 MeV bombarding energy, and from the reactions $Be^9(d,p)Be^{10}$, $B^{10}(d,p)B^{11}$ and $Ca^{40}(d,p)Ca^{41}$ at 8.9 MeV bombarding energy was measured at certain angles of emission. The sign of the polarization was found to be positive when $j_n = l_n + \frac{1}{2}$ and negative when $j_n = l_n - \frac{1}{2}$ except for the reaction $Ca^{40}(d,p)Ca^{41}$. The results of the $C^{12}(d,p)C^{13}$ measurements suggest that the polarization does not vary rapidly with bombarding energy.

539.17

2801. THE REACTION $Mg^{24}(d,p)Mg^{25}$ AT $E_d = 1.082$ MeV.
H.Risti and T.Grotdal.
Univ. Bergen Arbok, 1958, No. 14, 8 pp.

Energies and angular distributions were measured of some of proton groups emitted from a 35 μg /cm² Mg^{24} target bombarded with 1.082 MeV deuterons. The proton angular distributions are compared, when possible, with those calculated from the stripping theories enabling assignments of spins and parities to be made to the levels of the residual nucleus. A spin and parity assignment of 3/2 or 5/2, even parity, is made for the 3.899 MeV level in Mg^{25}. The relative yield of the different groups is also found.

539.17 : 539.12

2802. INELASTIC SCATTERING OF DEUTERONS ON THE Mg^{24} NUCLEUS. T.I.Kopaleĭshvili and V.I.Mamasakhlisov.
Zh. eksper. teor. Fiz., Vol. 35, No. 4(10), 1017-19 (1958).
In Russian.

The angular distribution of inelastically scattered deuterons on the Mg^{24} nucleus accompanied by excitation of the 2^+ (4.23 MeV) level due to excitation of a deformation quantum is investigated. Nuclear as well as electric interaction of the deuteron with the nucleus is taken into account. A comparison of the theory with the experimental data is carried out.

539.17

2803. EXCHANGE EFFECTS IN STRIPPING REACTIONS.
V.G.Neudachin.
Zh. eksper. teor. Fiz., Vol. 35, No. 5(11), 1165-70 (1958). In Russian.

Formulae for the differential cross-sections of the stripping reactions (d,p) or (d,n) have been obtained in the Born approximation, taking into account the antisymmetry of the total wave function. The most important case of shell configuration j^{n-1} for the initial nucleus, and j^n for the final nucleus, is considered.

539.17

2804. THE YIELD OF THE $Ni^{60}(d,2n)Cu^{60}$ REACTION.
R.Radicella, J.Rodriguez, G.B.Baró and O.Hittmair.
Z. Phys., Vol. 153, No. 3, 314-16 (1958). In German.

The total cross-section of the process is studied in the energy range of 9.0 to 27.4 MeV. The measurements are made by the comparison of the saturation activity of Cu^{60} with that of Na^{24}, the production cross-section of which is known and which is made concurrently by the irradiation of Al^{26}. Approximate agreement with theory is achieved if the reaction is assumed to proceed by deuteron stripping.
S.J.St-Lorant

539.17 : 539.163.2

2805. T(t,α)n,n REACTION. N.Jarmie and R.C.Allen.
Phys. Rev., Vol. 111, No. 4, 1121-8 (Aug. 15, 1958).

The alpha particle spectra from the reaction was measured at a laboratory angle of 30° for triton energies ranging from 0.95 to 2.10 MeV and at laboratory angles of 30°, 60°, 90° and 120° for 1.9 MeV incident tritons. Absolute cross-sections were obtained. Analysis of the spectra in terms of a two-stage process involving the formation and breakup of He^5 is discussed. Evidence for neutron—neutron correlation is observed but no evidence is found for a bound dineutron.

539.17

2806. TRITON REACTION CROSS SECTIONS.
R.C.Allen and N.Jarmie.
Phys. Rev., Vol. 111, No. 4, 1129-30 (Aug. 15, 1958).

Measurements of the D(t,α)n reaction cross-section at triton energies of 1.9 and 1.5 MeV were made to resolve a disagreement among previously published values. Corrections for published values of the $He^4(t,t)He^4$ and T(t,t)T scattering cross-sections are also suggested.

539.17

2807. $N^{14}(\alpha,\alpha)N^{14}$ AND $N^{14}(\alpha,p)O^{17}$ DIFFERENTIAL CROSS SECTIONS. D.F.Herring, R.Chiba, B.R.Gasten and H.T.Richards.
Phys. Rev., Vol. 112, No. 4, 1210-16 (Nov. 15, 1958).

The cross-sections were measured for α-particle bombarding energies from 2.0 to 3.8 MeV. A differentially-pumped gas scattering chamber was used. The $N^{14}(\alpha,\alpha)N^{14}$ differential cross-sections were measured at centre-of-mass angles of 170.8°, 140.6°, 125.1° and 91.0°. Resonances were observed at 2.351, 2.370, 2.767, 2.868, 2.870, 3.080, 3.576 MeV and ~ 3.67 and ~ 3.71 MeV. The $N^{14}(\alpha,p)O^{17}$ differential cross-sections were measured for α-particle bombardin energies from 2.7 to 3.8 MeV at centre-of-mass angles of 169.7°, 135.6°, 119.0° and 84.7°. Resonances in the $N^{14}(\alpha,p)O^{17}$ differential cross-section were observed at α-particle bombarding energies of 2.868, 3.080 and 3.69 MeV.

539.17

2808. A STUDY OF THE $B^{10}(\alpha,p)C^{13}$ REACTION USING PHOTOGRAPHIC EMULSIONS. A.Papkow.
Z. Naturforsch., Vol. 11a, No. 10, 776-82 (1956). In German.

Measurement of proton ranges in 100 μ Ilford C2 emulsion from the $B^{10}(\alpha,p)C^{13}$ reaction shows no evidence for the existence of an intermediate energy level at 700 keV in C^{13}. A Q-value of 4.10 MeV for the reaction is obtained. The angular distribution of the protons in 200 μ Ilford G5 emulsion is nearly isotropic between the angles 0-90°, and shows a pronounced peak at 120° and a sharp rise between 160-180°. A ratio of 2 : 1 for the differential cross-section for intermediate nucleus formation to the cross-section for heavy particle stripping is estimated assuming a symmetric angular distribution about 90° of protons from the N^{14} intermediate nucleus.
S.J.St-Lorant

539.17 : 539.14

ENERGY LEVELS IN F^{18} FROM THE $N^{14}(\alpha,\alpha)N^{14}$ AND $N^{14}(\alpha,p)O^{17}$ REACTIONS. See Abstr. 2707

539.17 : 539.12

2809. HIGH-ENERGY ELECTRON SCATTERING FROM NUCLEI WITH FINITE CHARGE DISTRIBUTIONS. H.S.Valk.
Nuovo Cimento, Vol. 10, No. 2, 200-4 (Oct. 16, 1958).

By applying a relativistic extension of Molière's formula for the electron scattered amplitude to the particular case of potentials generated by radial charge distributions of finite extent, it is shown that the amplitude can be resolved into three distinct contributions: (1) the Mott point-charge scattered amplitude; (2) a correction to this arising from the finite radial cut-off and (3) a term characteristic of the charge distribution. The resulting expression is applied to the case of a uniform charge distribution for which an optical analogy is indicated.

539.17

2810. CASCADE CURVES FOR COPPER.
I.P.Ivanenko and B.E.Samosudov.
Zh. eksper. teor. Fiz., Vol. 35, No. 5(11), 1265-70 (1958).
In Russian.

Electron cascade curves in copper are calculated for primary electron or photon energies $10^7 <\sim E <\sim 10^{12}$ eV by the momentum method. The calculation allows for the dependence of the total photon absorption coefficient on energy and for Rutherford scattering of the charged particles. A short analysis of the numerical results is carried out.

539.17 : 535.345 : 537.531

2811. THE NUCLEAR ABSORPTION OF X-RAYS BY OXYGEN.
A.K.M.Siddiq and R.N.H.Haslam.
Canad. J. Phys., Vol. 36, No. 7, 963-76 (July, 1958).

The total X-ray attenuation ratio in water was measured as a function of energy in the region 15-25 MeV, with a view to studying the nuclear absorption process in oxygen. The known energy response characteristics of several "activity detectors" [$Zn^{64}(\gamma,n)Zn^{63}$, $C^{12}(\gamma,n)C^{11}$, $S^{32}(\gamma,d)P^{30}$, $O^{16}(\gamma,n)O^{15}$] to bremsstrahlung were employed n these measurements. The experimental values of the attenuation ratios were compared to the predicted values calculated on the basis of various assumptions concerning the nuclear absorption process. The best description of the nuclear absorption process in oxygen appears to be continuous absorption on which relatively small absorption peaks are superimposed.

539.17 : 539.12

2812. ON THE ANGULAR DISTRIBUTION OF THE PARTICLES OF PHOTODISINTEGRATED CARBON.
F.I.Havliček and B.Dobovišek.
"J. Stefan" Inst. Rep., Vol. 2, 73-6 (May, 1955).

Angular distributions of the α-particles in the photodisintegration $C^{12}(\gamma, 3\alpha)$ were measured in emulsion, for photon energies up to 27 MeV.
P.G.Murphy

539.17

2813. THE (γ,n) REACTION IN ^4He NUCLEI.

D.L.Livesey and I.G.Main.
Nuovo Cimento, Vol. 10, No. 4, 590-6 (Nov. 16, 1958).

The photographic plate method was used to detect He^3 particles emitted from helium gas exposed to bremsstrahlung of maximum energy 70 MeV. The $He^4(\gamma,n)He^3$ cross-section is found to vary between values of (0.63 ± 0.10) mb at 40 MeV and (0.25 ± 0.04) mb at 60 MeV, the integrated cross-section being 7.5 MeV mb between these limits. The angular distribution of the He^3 particles in the c.m. system has a peak in the forward direction and may be described by the expression $f(\theta) = B \sin^2\theta(1 + C \cos\theta)$ with C approximately equal to 0.5.

539.17

2814. (γ, p) REACTIONS IN Na^{23}, K^{39}, I^{127} AND Cs^{133}.

L.Keszthelyi and J.Erő.
Nuclear Phys., Vol. 8, No. 6, 650-60 (Nov. [2], 1958).

Proton spectra of $K^{39}(\gamma,p)A^{38}$, $Na^{23}(\gamma,p)Ne^{22}$, $I^{127}(\gamma,p)Te^{126}$ and $Cs^{133}(\gamma,p)Xe^{132}$ reactions were investigated by irradiating KI:Tl, NaI:Tl and CsI:Tl crystals by $Li(p,\gamma)$ gamma-rays, and the corresponding cross-sections were determined. Electron background was reduced by placing a guard crystal in front of the target crystal. Approximate cross-sections are 15 ± 5.8 millibarns for $K^{39}(\gamma,p)$; 3.6 ± 1.5 millibarns for $Na^{23}(\gamma,p)$ and 1.5 ± 0.6 millibarns for $I^{127}(\gamma,p)$ and $Cs^{133}(\gamma,p)$ reactions at 17.6 MeV γ-energy. The proton spectrum of $K^{39}(\gamma,p)$ reaction shows peaks at 6.1, 9.2 and 11 MeV corresponding to the 5, 2.15 and 0 MeV levels of A^{38}. The $I^{127}(\gamma,p)$ and $Cs^{133}(\gamma,p)$ spectra are inconsistent with the statistical theory owing to the effect of direct interaction.

539.17

2815. THE EVAPORATION THEORY OF PHOTO-NUCLEAR REACTIONS. J.A.Evans.

Proc. Phys. Soc., Vol. 73, Pt 1, 33-9 (Jan., 1959).

There is considerable disagreement between the predictions of the evaporation (or statistical) theory, and the experimental results for the ratio of emission probabilities of protons and neutrons from a heavy nucleus excited by γ-ray absorption. This investigation deals with refinements which can be made to the evaporation theory; namely, the use of accurate experimental nucleon separation energies, and the assumption of a realistic, diffuse nuclear surface. Penetrabilities are calculated for the nucleus Sn^{118}, assuming a diffuse nuclear surface, and it is found that proton emission is enhanced by a factor of about 4. Finally, the effects of shell structure are discussed in connection with the densities of levels in the residual nuclei. It is found that the theory still predicts far less proton emission than is actually observed.

539.17

2816. NUCLEAR DEFORMATION AND THE PHOTODISINTEGRATION GIANT RESONANCES. J.H.Carver and W.Turchinetz.

Proc. Phys. Soc., Vol. 73, Pt 1, 69-80 (Jan., 1959).

The effects of nuclear deformation and shell closure upon the photodisintegration giant resonances were investigated by measuring the (γ,n) cross-sections for seven isotopes with $82 \leq N \leq 108$ using the bremsstrahlung from the 33 MeV Canberra electron synchrotron. The induced radioactivities were measured with a NaI:Tl scintillation spectrometer. The most accurate results were obtained for the $Ta^{181}(\gamma,n)$ reaction leading to the 8.15 hour isomeric level of Ta^{180}, the yield of which was measured to $\frac{1}{2}\%$ statistical accuracy at 250 keV intervals over the rising part of the activation curve. The giant resonance for the reaction measured in this way has a width of 5.3 MeV and shows no evidence for the splitting into two components predicted by recent calculations on the photodisintegration of spheroidal nuclei. In qualitative agreement with these calculations, it was found that the (γ,n) cross-sections for the other distorted nuclei investigated, Nd^{150}, Sm^{154} and Gd^{160}, have widths of 5.7, 6.5 and 5.3 MeV respectively, while for the closed-shell nuclei Pr^{141}, Nd^{142} and Sm^{144}, the corresponding (γ,n) cross-sections have widths of 4.3, less than 5.0 and 4.0 MeV. In addition, it was found that the (γ,n) cross-sections for closed-shell nuclei have substantially larger high-energy tails than do those for spheroidal nuclei.

539.17

2817. PHOTODISINTEGRATION OF THE DEUTERON AT 130 MeV. A.F.Nicholson and G.E.Brown.

Proc. Phys. Soc., Vol. 73, Pt 2, 221-6 (Feb., 1959).

The cross-section for photodisintegration is calculated assuming the Siegert theorem to be valid. The neutron and proton wavefunctions are obtained by integrating the Schrödinger equation. Potentials given by Gammel and Thaler (Abstr. 7971/1957, 6137/1958) are employed in both the ground state of the deuteron and in the final state. Results for the cross-section obtained with retardation differ only slightly from those in which it is neglected. Final results for the cross-section give a value slightly smaller than the experimental one, but do not seem to indicate that a modification in the radiative interaction is necessary.

539.17

2818. CROSS-SECTION OF THE $O^{16}(\gamma,p)$ REACTION AT 28 MeV.

P.Brix and E.K.Maschke.
Z. Naturforsch., Vol. 12a, No. 12, 1013-14 (1957). In German.

The energy distribution of protons from the $O^{16}(\gamma,p)$ reaction, in 200μ Ilford C2 emulsion, confirms the resonance in the γ-spectrum of O^{16} at 11.2 MeV and yields a value of $\sigma = 2.3$ mb for the reaction at 28 MeV. No errors are quoted.
S.J.St-Lorant

539.17 : 539.12

2819. INVESTIGATION OF 15-65 MeV PROTONS PRODUCED IN THE PHOTODISINTEGRATION OF Al AND Ni.

E.B.Bazhanov, Yu.M.Volkov and L.A.Kul'chitskiĭ.
Zh. eksper. teor. Fiz., Vol. 35, No. 2(8), 322-7 (1958). In Russian.

The angular distributions of photoprotons from Al and Ni were investigated for a peak bremsstrahlung energy $E_{max} = 85$ MeV and the energy distributions of photoprotons from Al were studied for angles of 30°, 90° and 130° for $E_{max} = 90$ MeV. The results are discussed from the viewpoint of the quasi-deuteron mechanism of interaction between γ-quanta and nuclei.

539.17

2820. STUDY OF PROTONS EMITTED BY Mn^{55} AND As^{75} WHEN BOMBARDED WITH 14 MeV NEUTRONS. P.Avignon and L.Rosier.

C.R. Acad. Sci. (Paris), Vol. 247, No. 21, 1849-52 (Nov. 24, 1958). In French.

Energy spectra of the emitted protons are given and the results compared with those calculated using the statistical model.
C.J.Batty

539.17

2821. THE THERMAL NEUTRON CAPTURE CROSS SECTION AND THE RESONANCE ABSORPTION INTEGRAL OF Th^{230}(IONIUM).

M.J.Cabell.
Canad. J. Phys., Vol. 36, No. 8, 989-96 (Aug., 1958).

The thermal-neutron capture cross-section and the resonance capture integral of Th^{230} were determined by an activation method. Assumptions are made that the thermal capture cross-section and the resonance capture integral of Co^{59} are 36.5 barns and 48.6 barns respectively, that the half-life of Th^{230} is 8.00×10^4 years, and that Th^{230} behaves as a 1/v absorber in the subcadmium region. Based on these assumptions values of $\sigma_{2200} = 21.4 \pm 0.3$ barns and of 937 ± 32 barns for the resonance absorption integral (from 0.5 eV to ∞) were obtained for Th^{230}. The half-life of Th^{231} was determined as 25.52 ± 0.01 hours.

539.17

2822. NEUTRON CAPTURE CROSS SECTION OF I^{129} AND I^{130}.

J.C.Roy and D.Wuschke.
Canad. J. Chem., Vol. 36, No. 10, 1424-30 (Oct., 1958).

The capture cross-section of I^{129} for 2200 m/sec neutrons and its resonance capture integral were determined by counting the beta-rays emitted by the 12.5 hr I^{130} formed by an (n,γ) reaction on I^{129}. The σ_{2200} was found to be 26.7 ± 2.0 barns and the resonance capture integral 36 ± 4.0 barns. The effective capture cross-section of I^{130} for reactor neutrons was measured to be 18.0 ± 3.0 barns by counting the beta-rays emitted by the 8.1 day I^{131} produced by successive neutron capture in I^{129}. The neutron fluxes were measured with cobalt monitors; the thermal cross-section and the resonance capture integral of Co^{59} were taken to be 36.5 and 48.6 barns.

539.17

2823. NEUTRON RESONANCE PARAMETERS OF TANTALUM FROM 20 TO 100 eV. F.W.K.Firk.

Nuclear Phys., Vol. 9, No. 2, 198-204 (Dec. [1], 1958).

Values of the peak total cross-section (σ_0) and the total width (Γ) for thirteen resonances in Ta between 20 and 100 eV were determined using a 15 MeV linear accelerator and time-of-flight spectrometer. The radiation widths $(\Gamma\gamma)$ were obtained assuming the spin weighting factor $g = \frac{1}{2}$. Refinements in the methods of analysis of transmission data have enabled the parameters to be determined. These methods include a general "area" analysis which includes the effect of interference between resonance and potential scattering.

539.17 : 539.14

2824. RADIATION WIDTHS OF NEUTRON RESONANCES IN Ta.
J.E.Evans, B.B.Kinsey, J.R.Waters and G.H.Williams.
Nuclear Phys., Vol. 9, No. 2, 205-17 (Dec. [1], 1958).

The radiation widths of 12 neutron resonances in Ta were determined from a combination of transmission, resonance scattering, and capture measurements. The spins of the compound states corresponding to two of these resonances were found; both were of spin 4. In addition an unresolved pair near 35 eV, are probably both spin 4. The radiation widths of those with spin 4 were close to a mean value of 63 MeV.

539.17

2825. ACTIVATION CROSS-SECTIONS FOR REACTION OF CHLORINE AND COPPER WITH 14.8 MeV NEUTRONS.
R.S.Scalan and R.W.Fink.
Nuclear Phys., Vol. 9, No. 2, 334-6 (Dec. [1], 1958).

Absolute neutron activation cross-sections at 14.8 MeV were measured for chlorine and for the $Cu^{65}(n,p)$ reaction, based on comparison with the $Cu^{63}(n,2n)Cu^{62}$ reaction (556 millibarns) which was used as a standard monitor for the neutron flux. The observed reactions, half-lives, and cross-sections are: $Cl^{37}(n,p)S^{37}$, 5.0 min, 25.4 ± 2.1 millibarns; $Cl^{37}(n,\alpha)P^{34}$, 12.5 sec, 43.8 ± 6.9 millibarns; $Cl^{35}(n,\alpha)P^{32}$, 14.5 days, 122 ± 56 millibarns; $Cl^{35}(n,2n)Cl^{34m}$ (upper state), 32.4 min, 5.6 ± 2.0 millibarns; $Cl^{35}(n,2n)Cl^{34g}$ (ground-state), 1.5 sec, 2.8 ± 0.5 millibarns; and, from the copper monitor, $Cu^{65}(n,p)Ni^{65}$, 2.56 hr, 31 ± 13 millibarns. Comparison of the chlorine cross-sections with values estimated according to the compound nucleus theory as outlined by Blatt and Weisskopf show the usual deviations. These deviations are attributed to inadequacies in the simple version of the compound nucleus theory.

539.17

2826. $Li^6(n,t)He^4$ CROSS SECTION FOR 12.5 TO 18.3 MeV NEUTRONS. B.D.Kern and W.E.Kreger.
Phys. Rev., Vol. 112, No. 3, 926-30 (Nov. 1, 1958).

The neutrons were obtained from the $T(d,n)He^4$ reaction and their flux density was determined by counting the recoil He^4 particles. A $Li^6I(Eu)$ scintillation crystal 1½ in. in diameter by ½ in. thick served as both the Li^6 sample and the detector for the reaction products. The cross-section is nearly linear from 34.3 millibarns at 12.5 MeV to 17.6 millibarns at 18.3 MeV. It is 28.1 ± 1.6 millibarns at 14.2 ± 0.2 MeV.

539.17

2827. (n,t) CROSS SECTIONS FOR B^{10}, B^{11} AND Be^9.
M.E.Wyman, E.M.Fryer and M.M.Thorpe.
Phys. Rev., Vol. 112, No. 4, 1264-6 (Nov. 15, 1958).

The tritium yield was determined by absolute counting of the beta activity. Neutron fluxes were measured by standard techniques. The following values were obtained for the cross-sections at the indicated neutron energies: Be^9 at 14.1 MeV, 18 ± 1.5 mb; B^{10} at 4 MeV, 95 ± 10 mb; B^{10} at 5.6 MeV, 230 ± 25 mb; B^{10} at 9.6 MeV, 125 ± 15 mb; B^{10} at 14.1 MeV, 85 ± 6 mb; B^{10} for fission spectrum, 30 ± 2 mb; B^{11} at 14.1 MeV, 15 ± 5 mb.

539.17 : 539.12

2828. LOW ENERGY ELASTIC SCATTERING OF NEUTRONS BY DEUTERONS WITH YUKAWA INTERACTION.
F.A.Haas and H.H.Robertson.
Proc. Phys. Soc., Vol. 73, Pt 2, 160-8 (Feb., 1959).

Five phase shifts are determined for scattering of neutrons by deuterons in the energy range 0-10 MeV. The central type interaction assumed has Yukawa radial dependence, the range and depth of this well being consistent with two-body data. Representation of the deuteron ground state is achieved by means of the Hulthén wavefunction. The resonating group structure method as applied by Buckingham and Massey (Abstr. 2721/1941) is used to obtain the scattering integro-differential equation which is solved exactly.

539.17 : 539.12

2829. INELASTIC SCATTERING OF NEUTRONS BY THORIUM.
R.Batchelor and J.H.Towle.
Proc. Phys. Soc., Vol. 73, Pt 2, 193-200 (Feb., 1959).

The inelastic scattering of neutrons of up to 1.6 MeV energy by natural thorium and uranium was studied using the millimicrosecond time-of-flight technique. Scattering was observed to levels in Th^{232} at ~0.05, 0.150 ± 0.015, (0.30 + 0.02), 0.79 (two levels) and 1.09 ± 0.02 MeV. The data obtained for U^{238} are in agreement with previous work. Differential cross-sections measured at 90° are also reported.

539.17

2830. CROSS SECTIONS FOR (n,p) AND (n,α) REACTIONS WITH 14.5 MeV NEUTRONS. R.F.Coleman, B.E.Hawker, L.P.O'Connor and J.L.Perkin.
Proc. Phys. Soc., Vol. 73, Pt 2, 215-20 (Feb., 1959).

Activation methods were used to measure twenty-seven (n,p) and twenty-two (n,α) cross-sections at 14.5 MeV for target nuclides in the mass range $100 < A < 250$. Radiochemical separations were made in every case. The (n,p) cross-sections fell gradually from 10 to 1 millibarns over the mass range examined. No trend was apparent for the (n,α) cross-sections measured, which were all of the order of 0.3 to 3.0 millibarns. The (n,p) cross-sections are in good agreement with the predictions of the direct interaction theory of Brown and Muirhead (Abstr. 5619/1957).

539.17

2831. ABSOLUTE CROSS-SECTIONS FOR THE REACTIONS $K^{39}(n,p)A^{39}$ AND $K^{39}(n,\alpha)Cl^{36}$ WITH 2.6 MeV NEUTRONS.
G.Lindström and H.Neuert.
Z. Naturforsch., Vol. 13a, No. 10, 826-9 (Oct., 1958). In German.

The former cross-section is found to be 45 millibarns ± 10% and the latter, 36 millibarns ± 10%, using an improved $n-He^3$ coincidence apparatus. Comparison with the continuum theory gives $R = 3.65 \times 10^{-13}$ cm as the effective radius of A^{39}, and $R = 7.27 \times 10^{-13}$ cm as that of Cl^{36}. G.E.Brown

539.17

2832. ON THE THEORY OF INTERACTION BETWEEN FAST NEUTRONS POSSESSING VARIOUS ANGULAR MOMENTA AND SEMI-TRANSPARENT NUCLEI. L.É.Pargamanik and V.V.Ul'yanov.
Zh. eksper. teor. Fiz., Vol. 35, No. 1(7), 258-64 (1958). In Russian.

The participation of fast neutrons with various angular momenta in the interaction with semi-transparent nuclei is studied within the framework of the complex square well nuclear model. The exact expressions for the partial cross-sections are approximated with help of special asymptotic formulae for cylindrical functions which are valid throughout the complete angular momentum range. This approximation permits one to determine with greater precision the significance of waves with angular momenta $l \sim kR$ in neutron scattering and absorption processes as compared with the results derived in the quasi-classical approximation. Corrections to the integral absorption and scattering cross-sections are obtained which are appreciable at high and low effective absorption.

539.17

2833. OPTICAL MODEL FOR INTERACTION BETWEEN MEDIUM-ENERGY NEUTRONS AND NUCLEI.
A.V.Luk'ganov, Yu.V.Orlov and V.V.Turovtsev.
Zh. eksper. teor. Fiz., Vol. 35, No. 3(9), 750-6 (1958). In Russian.

An optical nuclear model is investigated in which the nucleus is described by a complex potential with a tail possessing the form of a third degree polynomial. Paramaters of the model were found which yield the best agreement between the theoretical cross-sections σ_t, σ_r, and σ_s with the experimental values for 14 MeV neutrons. For nuclei heavier than chromium the agreement is quite satisfactory. The angular distribution of elastically scattered neutrons computed on the basis of the above mentioned parameter values are also in satisfactory agreement with experiment. A preliminary study of the region of smaller energies indicates that the parameters depend weakly on the energy over a comparatively broad range.

539.17

2834. INVESTIGATION OF THE $n + p \rightarrow \pi^0 + d$ REACTION FOR 660 MeV EFFECTIVE ENERGY NEUTRONS AND THE HYPOTHESIS OF CHARGE INDEPENDENCE.
V.B.Flyagin, V.P.Dzhelepov, V.S.Kiselev and K.O.Oganesyan.
Zh. eksper. teor. Fiz., Vol. 35, No. 4(10), 854-67 (1958). In Russian.

The angular distribution and total cross-section for production of π^0-mesons in the $n + p \rightarrow \pi^0 + d$ reaction was investigated for 660 MeV neutrons. An arrangement is employed which permits one to record coincidences between one of the quanta of a decaying π^0-meson and the deuteron. Gamma quanta were recorded with a scintillation counter telescope containing a lead convertor. The deuterons were analysed with a multi-channel magnetic spectrometer. The angular distribution thus obtained $(0.220 \pm 0.022) + \cos^2\theta$ (in the c.m.s.) and the total cross-section for the reaction $(1.5 \pm 0.3) \times 10^{-27}$ cm^2 confirm the validity of the hypothesis of charge independence of nuclear forces.

539.17

2835. ON THE MECHANISM OF STRIPPING IN REACTIONS INVOLVING CAPTURE OF TWO NUCLEONS.
V.V.Komarov, V.G.Neudachin, A.M.Popova and I.B.Teplov.
Zh. eksper. teor. Fiz., Vol. 35, No. 4(10), 974-7 (1958). In Russian.

Reactions of the (n,t) type are examined qualitatively. Two competing processes are discussed: (a) the process of "successive stripping" (n—d—t); (b) the process of simultaneous capture of the two nucleons.

539.17 : 539.12

MEASUREMENT OF THE TOTAL CHARGED π-MESON PRODUCTION CROSS SECTION IN N—P COLLISIONS AT NEUTRON ENERGY 586 MeV. See Abstr. 2638

539.17 : 539.166

γ-EMISSION IN RADIATIVE CAPTURE OF THERMAL NEUTRONS BY Mo^{95}, Ag^{107}, Te^{123} AND Cs^{133} NUCLEI. See Abstr. 2761

539.17 : 539.166.2

INELASTIC NEUTRON SCATTERING IN Na^{23}. See Abstr. 2764

539.17 : 539.166.2

RESONANCE NEUTRON CAPTURE IN INDIUM. See Abstr. 2765

539.17 : 539.12

2836. K^--ABSORPTION IN NUCLEI, AN ISOBARIC SPIN AND ANGULAR MOMENTUM ANALYSIS. P.K.Roy.
Nuclear Phys., Vol. 9, No. 2, 314-25 (Dec. [1], 1958).

The consequences of the conservation of isobaric spin in K^--meson capture on a pair of nucleons are investigated. Certain relations involving production cross-sections and capture and production ratios are derived; the effect of the assumption of the predominance of the final baryonic or meson—nucleon interaction is determined. Similar considerations are applied to the absorption processes in light nuclei like deuteron and helium, etc. Lastly, an angular momentum analysis of the absorption processes is considered to determine the relative parities of the K and Y particles.

539.17 : 537.591.8

NUCLEAR DISINTEGRATIONS PRODUCED BY CHARGED COSMIC RAYS. See Abstr. 2479

539.17 : 539.12

K^--PROTON CAPTURE IN NUCLEAR EMULSIONS. See Abstr. 2651

539.17 : 537.591.8

2837. INTERACTION OF COSMIC-RAY PARTICLES WITH VARIOUS NUCLEI.
N.L.Grigorov, A.V.Podgurskaya, A.I.Savel'eva and L.M.Poperekova.
Zh. eksper. teor. Fiz., Vol. 35, No. 1(7), 3-15 (1958). In Russian.

The transition effects of stars and single heavily ionizing particles produced in photographic plates at altitudes of 9 and 20 km was studied using various types of filters. The experimental data thus obtained indicate that the number of particles in stars and the mean disintegration energy of the stars is proportional to $A^{1/3}$. Due to constancy of the flux of heavily ionizing particles and of their spectrum in air and lead it was possible to analyse previously obtained results (1953) on π^0-meson production in air and lead. It is shown that the mean energy carried off by π^0-mesons produced in the interaction of $\sim 10^{10}$ eV primary cosmic-ray particles with nuclei is proportional to the radius of the nucleus target.

539.17

2838. THE MECHANISM OF NEUTRON EMISSION IN HIGH ENERGY FISSION. D.M.Skyrme and G.N.Harding.
Nuovo Cimento, Vol. 9, No. 6, 1082-4 (Sept. 16, 1958).

A measurement was made of the energy spectrum of neutrons evaporated from uranium bombarded with 150 MeV protons, using nuclear emulsion technique. The mean kinetic energy of the neutrons is found to be (2.4 ± 0.2) MeV.

539.17

2839. FURTHER RADIOCHEMICAL STUDIES OF THE HIGH-ENERGY FISSION PRODUCTS.
P.C.Stevenson, H.G.Hicks, W.E.Nervik and D.R.Nethaway.
Phys. Rev., Vol. 111, No. 3, 886-91 (Aug. 1, 1958).

Formation cross-sections of various U^{238} fission products were measured as a function of bombarding-particle energy, using protons (10-340 MeV) and deuterons (20-190) MeV). The reactions $Al^{27}(p,3pn)Na^{24}$ and $Al^{27}(d,\alpha p)Na^{24}$ were used as monitoring reactions to measure effective cyclotron beam intensity. Fission-product distribution curves and total fission cross-sections were measured. Above 50 MeV bombarding energy, the fission-product distribution is not symmetrical about a given mass number at a given bombardment energy.

539.17

2840. FISSION OF SILVER NUCLEI BY HIGH-ENERGY PROTONS. V.P.Shamov.
Zh. eksper. teor. Fiz., Vol. 35, No. 2(8), 316-21 (1958). In Russian.

Some parameters relating to fission of silver nuclei by protons possessing energies between 300 and 660 MeV are investigated. An analysis of the experimental data shows that: (1) fission of silver nuclei induced by high-energy protons leads predominantly to the formation of fragments of equal masses; (2) the fission cross-section does not significantly vary in the investigated energy range of the incident protons and is $\sigma = (3.2 \pm 1) \times 10^{-28}$ cm^2; (3) as a rule fission is accompanied by the emission of a large number of charged particles which indicates that the initial degree of excitation of the fissioning nuclei is quite large. The complete curve for the yield of residual nuclei as a function of charge is presented and also the differential yield curves for various nuclear interaction processes such as fragmentation, fission and the cascade-evaporation process.

539.17

2841. ON TRIPLE DISINTEGRATIONS OF URANIUM NUCLEI.
N.A.Perfilov and G.F.Denisenko.
Zh. eksper. teor. Fiz., Vol. 35, No. 3(9), 631-4 (1958). In Russian.

Disintegration of uranium nuclei into three multicharged particles by 460 and 660 MeV protons was studied. Two of the disintegration particles were of the heavy-fragment type and the third was of considerably smaller mass and charge. The yields for given proton energies, angular distribution of light multicharged particles (forward—backward ratio) and their charge and energy distribution were determined for the triple disintegrations mentioned above. A suggestion concerning the mechanism of such triple disintegrations is proposed and under the assumptions thus made the fragmentation cross-section for uranium nuclei is estimated.

539.17

2842. A RADIOCHEMICAL INVESTIGATION OF PHOTOFISSION OF Th^{232}. I.A.Vasil'ev and K.A.Petrzhak.
Zh. eksper. teor. Fiz., Vol. 35, No.5(11), 1135-40 (1958). In Russian.

12 fragments from the photofission of Th^{232} (peak bremsstrahlung energy of 10 MeV) were identified by a radiochemical method. The mass number dependence of the fission product yields was determined. The dependence of the peak-to-valley ratio of the Th^{232} and U^{238} photofission yield curves on the peak bremsstrahlung energy was determined in the energy range from 8 to 14 MeV. Results of calculation of the photofission of thorium and uranium by Fong's method (1956) are presented.

539.17

2843. A MEASUREMENT OF THE AVERAGE NUMBER OF PROMPT FISSION NEUTRONS FROM Th^{232} INDUCED BY IRRADIATION WITH 14 MeV NEUTRONS. J.Leroy.
C.R. Acad. Sci. (Paris), Vol. 247, No. 2, 200-2 (July 16, 1958). In French.

A collimated beam of 14 MeV neutrons from the $D(T,n)\alpha$ reaction was used to irradiate a double-fission chamber containing Th^{232} and U^{238}. By measuring the number of neutrons detected in coincidence with Th^{232} fissions and U^{238} fissions respectively it was possible to estimate the mean number of prompt-fission neutrons emitted by Th^{232} compared to the previously measured value of 4.55 ± 0.15 for U^{238}. The value obtained for Th^{232} was 4.64 ± 0.20

A.E.I. Research Laboratory

539.17

2844. SPONTANEOUS FISSION FRAGMENT VELOCITY MEASUREMENTS AND COINCIDENT GAMMA SPECTRA FOR Cf^{252}.
J.C.D.Milton and J.S.Fraser.
Phys. Rev., Vol. 111, No. 3, 877-85 (Aug. 1, 1958).

The velocities of both fission fragments from the spontaneous fission of Cf^{252} were measured simultaneously with the pulse-height spectrum produced by the fission gamma-rays in a large NaI(Tl) crystal. The average total kinetic energy before neutron emission is found to be 181.9 MeV with a full width at half maximum of 17.5 MeV at the most probable mass ratio 1.33. The width has been corrected for neutron recoil and the average total kinetic energy for the effect of the angular dispersion of the fragments by neutrons. The yield of gamma-rays shows a pronounced dip in the region where one of the fragments is near the doubly magic nucleus Sn^{132}. There is a suggestion that the average gamma-ray energy is higher in this region. The correlation in number of gamma-rays with total kinetic energy is very small and can be represented by

$$\frac{1}{\langle N_\gamma \rangle} \frac{dN_\gamma}{dE_T} = -0.0029_{-0.0011}^{+0.0007} \text{ MeV}^{-1}.$$

539.17

2845. CONTRIBUTION OF HIGH-ENERGY PARTICLES TO THERMONUCLEAR REACTION RATES. G.Eder and H.Motz.
Nature (London), Vol. 182, 1140-2 (Oct. 25, 1958).

The thermonuclear reaction rates for $D + D = He^3 + n$, $D + D = T + p$ and $T + D = He^4 + n$ were computed from the experimental data as a function of the relative energy of the colliding particles. It is seen that the maximum contributions to the reaction rates come from particles with rather high relative energy, i.e. about 4-5 times kT for DD- and 4-10 times kT for DT-reactions. Tables of total reaction rates and energies of maximum contribution are given for various plasma temperatures. The mean energies in the laboratory frame of reference of particles giving the maximum contribution are calculated as well as the energy in the laboratory frame of reference of those particles which have mean relative energies equal to the maxima of the reaction rate curves for various temperatures.
H.Motz

539.17

2846. FUSION CHAIN REACTION — CHAIN REACTION WITH CHARGED PARTICLES. M.Gryziński.
Phys. Rev., Vol. 111, No. 3, 900-5 (Aug. 1, 1958).

It is shown that in the case of a medium which is an exoergic nuclear mixture (a mixture of nuclei which can lead to an exoenergetic reaction) and which possesses a high temperature ($\sim 10^7$ °K) or a relatively high density ($\sim 10^4$ g.cm^{-3}), a fusion chain reaction can take place. This is due to the decrease in the stopping power of the medium under the conditions given above. Equations for determining the multiplication factor for a binary mixture under various physical conditions are derived. The multiplication factor is calculated for a DT mixture. It is concluded that for an exoergic nuclear mixture there exists a critical temperature or a critical density which limits the slow release of fusion nuclear energy. For an infinite medium of 50% DT mixture the critical temperature and the critical density are $\sim 10^7$ °K and $\sim 10^3$ g.cm^{-3}, respectively. In a finite medium the values are higher and there exists a critical mass which limits the possibility for the development of a fusion chain reaction. This critical mass was estimated and in first approximation is m_{cr} (in grams) = 1 (density of the medium in g.cm^{-3})^2.

539.17

2847. THE USE OF DIPOLE-SINGULARITIES FOR THE CALCULATION OF A HETEROGENEOUS REACTOR. H.Stippel.
Acta. phys. Austriaca, Vol. 12, No. 2, 123-43 (1958). In German.

The "source-sink" method for determining the neutron distribution and criticality data of a heterogeneous reactor is described. This method is applied to a reactor, consisting of cylindrical fuel rods in a moderator of infinite extent, using the simple diffusion theory to calculate the diffusion of neutrons between fuel rods. A generalization of this theory involving the mutual action of the fuel rods is given and the "mutual action" integral calculated.
D.H.Lord

539.17

2848. N.R.U. REACTOR NEUTRON LEVEL CONTROL SYSTEM. C.G.Lennox and A.Pearson.
I.R.E. Trans Nuclear Sci., Vol. NS-5, No. 2, 64-7 (Aug., 1958).

The system performs automatic start-up, as well as steady power control. The system characteristics and the circuits which determine them during start-up and under steady power control are described.

539.17 : 536.483

2849. A CRYOSTAT FOR REACTOR IRRADIATIONS IN LIQUID NITROGEN. M.W.Thompson and D.W.Jefferson-Loveday.
J. sci. Instrum., Vol. 35, No. 11, 397-9 (Nov., 1958).

A liquid nitrogen cryostat which has operated inside the BEPO reactor at Harwell is described. Provision was made for removing irradiated specimens in liquid nitrogen after periods of up to one month. Some difficulties encountered and the methods used to overcome them are discussed.

539.17

2850. FUEL TECHNOLOGY — U.S.A.
Nucleonics, Vol. 16, No. 8, 86-100 (Aug., 1958).

A series of articles reviewing the development of reactor fuel elements. Natural and enriched uranium, thorium and plutonium are considered separately. Experience with oxide fuels is reported. Methods of fabrication and a summary of physical properties are included.
R.D.Smith

539.17

2851. GASEOUS-FUEL REACTOR. S.Baron.
Nucleonics, Vol. 16, No. 8, 128, 130-3 (Aug., 1958).

A design study for a graphite-moderated, UF^6-fuelled, thermal reactor with a heat output of 35 MW. The fuel, at a pressure of 30 atm and a temperature of 900° F, is contained in double-walled aluminium tubes with helium coolant in the interspace. Plutonium and fission products can readily be separated from the UF^6.
R.D.Smith

539.17 : 518.5 : 621.317.79

2852. CONCERNING A SIMPLE REACTOR ANALOGUE. W.Ziegler.
Nucleonik, Vol. 1, No. 1, 27-9 (April, 1958). In German.

A new circuit arrangement for use in reactor analogues is described and its method of operation derived using the neutron kinetic equations. The system is no more complicated than the well-known reactor analogue circuits: however, the parameter used is the reactivity rather than the more usual effective reproduction factor.
A.J.Salmon

539.17 : 536.2

2853. HEAT TRANSFER PROBLEMS IN REACTOR TECHNOLOGY. W.Junkermann.
Nukleonik, Vol. 1, No. 2, 73-87 (July, 1958). In German.

Heat transfer methods and problems are surveyed. The following topics are discussed: the types of cooling cycle; the types of coolant (e.g. light and heavy water, organic liquids, liquid metals, gases, etc.); the required properties of coolants (e.g. low neutron absorption, little induced radio-activity and short half-life, stability at high temperature, etc.); a comparison of the various coolants; the special properties of certain coolants; descriptions of various types of heat exchanger; and corrosion problems.
D.H.Lord

539.17

2854. ON THE EFFICIENCY OF THE CONTROL RODS OF THERMAL REACTORS WITH REGARD TO THEIR DIAMETER, NUMBER AND ARRANGEMENT. W.Häfele.
Z. Naturforsch., Vol. 12a, No. 5, 368-77 (1957). In German.

The diffusion equation is solved, using single-group theory, for cylindrical reactors with control rings of 4, 6, 8 and 12 rods of various radii, and for reactors with two rings, each of four control rods. This single group treatment is sufficient for comparing the reduction of excess neutrons, produced by various control systems; however, to find the absolute value of this reduction two-group theory is required. Thus for a reactor with an axial control rod a "two-group correction" is deduced. Extensive numerical evaluations of the above results are carried out.
D.H.Lord

539.17 : 537.525.6

THE ELECTRON TEMPERATURE IN SCEPTRE III. See Abstr. 2379

539.17 : 537.591.5

NUCLEAR CASCADE PROCESSES. See Abstr. 1570

ATOMS

539.18

2855. THOMSON ATOM. H.Zatzkis.
Amer. J. Phys., Vol. 26, No. 9, 635-8 (Dec., 1958).

The historical development leading up to the Rutherford—Bohr model of the atom is briefly surveyed. The atomic model, suggested by J.J.Thomson before Rutherford's model, is investigated. The quantization shows that the bound states bear a marked resemblance to those of the hydrogen atom. However, the states are in general nondegenerate. Thus, the Thomson atom could not have survived the spectroscopic evidence even if no Rutherford scattering experiments had been performed.

539.18

2856. ON THE ENERGY LEVELS OF THE CONFIGURATION $6p^2$ IN Hg I. G.W.Charles.
J. Opt. Soc. Amer., Vol. 48, No. 9, 668 (Sept., 1958).

Lines at 2505.00 and 2774.80 Å in the Hg I arc spectrum are respectively assigned to the transitions $6s6p\ {}^1P_1^0 - 6p^2\ {}^3P_0$ and $6s6p\ {}^1P_1^0 - 6p^2\ {}^3P_1$. The positions of the ${}^3P_0$ and ${}^3P_1$ levels are thus determined, and an estimate is made of the position of ${}^3P_2$.
R.W.Nicholls

539.18

2857. THE $2^3S - 2^3P$, 3^3P, 3^3D, 4^3D EXCITATIONS OF HELIUM ATOMS BY ELECTRONS. B.L.Moiseiwitsch.
Monthly Not. Roy. Astron. Soc., Vol. 117, No. 2, 189-92 (1957).

Born's approximation is used to calculate the cross-sections for the excitation of the 2^3P, 3^3P, 3^3D and 4^3D states of helium from the metastable 2^3S state by electrons with energies ranging from the thresholds of the processes to about 100 eV. In the case of the $2^3S - 2^3P$ excitation a close coupling formula due to Seaton is also used.

539.18

2858. FERMI–SEGRÈ FORMULA. L.L.Foldy.
Phys. Rev., Vol. 111, No. 4, 1093-8 (Aug. 15, 1958).

A derivation of the nonrelativistic Fermi–Segrè formula for the probability of finding a valence s-electron at the nucleus of an atom in terms of the energy eigenvalues of the electron is presented, which makes use of the effective-range method drawn from scattering theory and a refinement of the JBWK method which avoids problems with the Coulomb singularity of the ion core potential.

539.18

2859. EFFECTS OF AN ELECTRIC DIPOLE MOMENT OF THE ELECTRON ON THE HYDROGEN ENERGY LEVELS. G.Feinberg.
Phys. Rev., Vol. 112, No. 5, 1637-42 (Dec. 1, 1958).

The bound states in a Coulomb field of a charged, spin $\frac{1}{2}$, particle with an electric dipole moment are obtained. The nonrelativistic Schrödinger equation for such a particle is solved in closed form. The wave-functions are generalizations of the Coulomb wave-functions, involving Laguerre polynomials of nonintegral upper index. The accidental degeneracies of the Coulomb energy levels are removed by the dipole interaction. In particular, there will be an additional contribution to the splitting between the $2S_{\frac{1}{2}}$ and $2P_{\frac{1}{2}}$ states coming from the dipole moment. By requiring that this extra energy shift should not destroy the agreement between the theoretical and experimental values of the Lamb shift, it is found that the dipole moment of the electron must be less than 10^{-13} cm times the electron charge. Other effects of the dipole moment on the hydrogen energy levels are discussed.

539.18

2860. GROUND STATE OF TWO-ELECTRON ATOMS. C.L.Pekeris.
Phys. Rev., Vol. 112, No. 5, 1649-58 (Dec. 1, 1958).

A new method is developed for solving the wave equation for two-electron atoms. The wave function is expanded into a triple orthogonal set in three perimetric coordinates. From the wave equation one obtains an explicit recursion relation for the coefficients in the expansion, and the vanishing of the determinant of these coefficients provides the condition for the energy eigenvalues and for the eigenvectors. The determinant was solved for $Z = 1$ to 10, using an iteration method. The nonrelativistic energy eigenvalues obtained for the ground state are lower than any previously published for all Z from 1 to 10. In the case of helium, the present nonrelativistic energy value is accurate to within 0.01 cm^{-1} and is 0.40 cm^{-1} lower than the value computed by Kinoshita. From the wave functions obtained, the mass-polarization and the relativistic corrections were evaluated for $Z = 1$ to 10. Using the values of the Lamb shift computed by Kabir, Salpeter, and Sucher, an ionization potential was obtained for helium of $198\,310.67\ cm^{-1}$ as against Herzberg's value of $198\,310.8_2 \pm 0.15\ cm^{-1}$. Comparison is also made with the available experimental data for the other values of Z.

539.18

2861. PROPERTIES OF THE METASTABLE HELIUM ATOMS. A.Dalgarno and A.E.Kingston.
Proc. Phys. Soc., Vol. 72, Pt 6, 1053-60 (Dec., 1958).

The available theoretical values of the oscillator strengths of dipole transitions from each of the metastable states of helium are modified so that each set satisfies four different sum rules. They are then employed to evaluate the polarizabilities, the diamagnetic susceptibilities, the average energy losses for fast particle impact, the Lamb shift average excitation energies and the van der Waals interactions between normal and metastable helium atoms.

539.18

2862. OPTICAL DETECTION OF NARROW Rb^{87} HYPERFINE ABSORPTION LINES. P.L.Bender, E.C.Beaty and A.R.Chi.
Phys. Rev. Letters, Vol. 1, No. 9, 311-13 (Nov. 1, 1958).

A new optical pumping method is used to modify the equilibrium distribution in the ground states. The intensity of scattered resonance radiation, measured by a photocell, is modified when the distribution between hyperfine components of the ground state is changed by a resonant microwave field. Changes in the hyperfine transition frequency with temperature and with various buffer gases are measured and tabulated.
G.F.Lothian

539.18 : 533.15

2863. THERMAL DIFFUSION FACTORS FROM COLUMN OPERATION. T.I.Moran and W.W.Watson.
Phys. Rev., Vol. 111, No. 2, 380-3 (July 15, 1958).

Extending the measurements of Corbett and Watson, the performance of a carefully-constructed, all-metal, hot-wire thermal diffusion column was determined for isotope spearations in neon, argon, krypton, and xenon. The same quantitative agreement with theory for normal argon gas at the low wall-temperature ratio of 2 is again found. This is probably fortuitous, for in general there is a discrepancy between the calculated and observed separation factors, with a trend in the data indicating that the assumptions of the theory that (1) the molecules are Maxwellian and (2) the thermal diffusion factors are constant, independent of temperature are at fault.

539.18

2864. INAPPLICABILITY OF CERTAIN HYDROMAGNETIC PRINCIPLES TO THE IONIC CENTRIFUGE. J.Slepian.
Phys. Rev. Letters, Vol. 1, No. 8, 287 (Oct. 15, 1958).

Suggests that the results of work on one-fluid hydromagnetic equations in the absence of particle collisions carried out by Chew, Goldberger, and Low (Abstr. 6794/1956) are not applicable to the ionic centrifuge (Abstr. 3927/1956, J. Franklin Inst., Vol. 263, No. 2, 129-39, Feb., 1957 and Nuclear Sci. Engng, Vol. 3, No. 1, 108-10, Jan., 1958).
C.G.Morgan

539.18 : 537.568

2865. ELASTIC SCATTERING OF SLOW IONS IN THEIR PARENT GASES. M.R.C.McDowell.
Proc. Phys. Soc., Vol. 72, Pt 6, 1087-96 (Dec., 1958).

Total elastic scattering cross-sections for H^+, H^-, He^+, Ne^+ and A^+ in their parent gases are calculated for energies between 0.1 eV and 10 keV, by an impact parameter method. The Massey–Mohr approximation is used for the phase shifts. The cross-sections vary as the square of the logarithm of the energy above 100 eV, but at some energy between this and 0.1 eV change to an inverse one-third power dependence. Approximate interaction energies for Ne_2^+ and A_2^+ at large R are obtained from charge-transfer data.

539.18

2866. IMPORTANCE OF DISTORTION IN INELASTIC ENCOUNTERS BETWEEN HEAVY SYSTEMS. D.R.Bates.
Proc. Phys. Soc., Vol. 73, Pt 2, 227-32 (Feb., 1959).

It is shown that distortion may have a considerable influence on excitation and ionization cross-sections even at quite high energies. Using an impact parameter treatment detailed calculations are carried out on the collision processes $H^+ + H(1s) \rightarrow H^+ + H(2s)$ and $He^{2+} + H(1s) \rightarrow He^{2+} + H(2s)$. The introduction of allowance for distortion is found to lead to much smaller cross-sections at low and moderate energies.

539.18 : 537.564

PROTON BOMBARDMENT OF HELIUM. See Abstr. 2453

539.18 : 539.12

2867. MEASUREMENT OF THE POLARIZATION OF NEGATIVE μ-MESONS IN CARBON, OXYGEN, MAGNESIUM, SULPHUR , ZINC, CADMIUM AND LEAD MESIC ATOMS.
A.E.Ignatenko, L.B.Egorov, B.Khalupa and D.Chultém.
Zh. eksper. teor. Fiz., Vol. 35, No. 5(11), 1131-4 (1958). In Russian.

Angular distributions of electrons from the decay of μ^--mesons in mesic atoms of C, O, Mg, S, Zn, Cd and Pb was measured with scintillation counters. The μ^--meson polarization was derived from results of measurements. The polarization is (19 ± 7)% for Mg, Zn, [Cd and Pb mesic atoms and (15 ± 4)% for C,O] and S mesic atoms. In substances in which the nuclear spins are zero μ^--meson depolarization can be mainly explained by spin–orbit interaction during the process of mesic atom formation; depolarization is also partially due to the action of the magnetic field of the atomic electron shell on the μ^--meson during its lifetime in the K-orbit.

539.18 : 539.12

DEPOLARIZATION OF μ^--MESONS IN [MESIC] HYDROGEN, DEUTERIUM AND TRITIUM. See Abstr. 2612

MOLECULES

539.19

2868. DEVELOPMENT OF A METHOD FOR DETERMINING THE RELAXATION PERIOD OF THE EXCITED VIBRATIONAL STATE OF MOLECULES BY MEANS OF THE SPECTROPHONE.

P.V.Slobodskaya.

Dokl. Akad. Nauk SSSR, Vol. 120, No. 6, 1238-41 (1958). In Russian.

For Vengerov's [Veingerov's] "spectrophone", see Abstr. 4575 (1938) and 2285 (1946). In a previous paper (Izv. Akad. Nauk SSSR, Ser. fiz., Vol. 12, No. 5, 656, 1948) the author suggested a selective method of determining the relaxation period using Vengerov's spectrophone, enabling this period to be determined for each molecule type independently of other molecules. The determination is carried out by measuring the phase shift of the signal developed by an optico-acoustical receiver filled with the tested gas, relative to the signal of a special generator which comprises a photocell illuminated with a light which is modulated synchronously with the radiation fed into the receiver. The measured phase shift is compensated by the displacement of the photocell along the arc of the modulating disk. The author analyses the mathematical expression of the pressure pulsation in the receiver, describes two methods of eliminating the phase shift due to the instrument itself (which depends on the concentration of the mixture), and presents the results of this method when applied to CO_2 molecules in mixture with N_2 for the bands at 4.3 and 2.7μ. F.Lachman

539.19

2869. INTERNAL BARRIER OF PROPYLENE OXIDE FROM THE MICROWAVE SPECTRUM. II.

D.R.Herschbach and J.D.Swalen.

J. chem. Phys., Vol. 29, No. 4, 761-76 (Oct., 1958).

For Pt I, see Abstr. 8048 (1957). Several long progressions of perpendicular transitions were measured in the microwave spectrum of propylene oxide. These provided an opportunity to test the theory of internal rotation over a very large range of rotational quantum numbers, $J = 1$ to 48 and $K = 1$ to 25, in the ground torsional state. For low K, the K doubling which arises from the asymmetry of the molecule is much larger than the splittings due to tunnelling through the potential barrier. The spectrum resembles that of an ordinary asymmetric rotor except that each line is split into a close doublet by the tunnelling. At high K, the K doubling becomes negligible. A triplet fine structure is observed in which the spacings show a periodic dependence on K, essentially the same as that calculated for the case of two coaxial symmetric tops. (For a true symmetric rotor, the selection rules would prevent the observation of this pattern.) At intermediate K, the K doubling and the tunnelling perturbations become comparable. The mixing of the rotational wavefunctions which results permits "forbidden" lines to appear. Very good agreement with theory is obtained over the whole range of K, with the barrier height $V_3 = 895\ \text{cm}^{-1}$ (2560 cal/M). Rotational transitions are also assigned for molecules in the first and second excited torsional states, in which the tunnel effect splittings are greatly magnified. For both the excited states, the barrier height is found to be identical with the ground state result. This supports the usual assumption that perturbations from vibrational interactions with internal rotation and from the sixfold V_6 term in the potential barrier are small enough to be safely neglected.

539.19

2870. PSEUDOROTATION IN CYCLOPENTANE AND RELATED MOLECULES. J.P.McCullough.

J. chem. Phys., Vol. 29, No. 4, 966-7 (Oct., 1958).

New measurements of the vapour heat capacity of cyclopentane confirm those of Pitzer and Spitzer (1946), but the better accuracy can be used to show that free pseudorotation must be present, a conclusion contrary to that of Abstr. 2545 (1951). J.Hawgood

539.1

2871. DETERMINATION OF HAMMETT SIGMA CONSTANTS B INTRAMOLECULAR HYDROGEN BONDING.

A.T.Shulgin and A.W.Baker.

Nature (London), Vol. 182, 1299 (Nov. 8, 1958).

The σ-values are obtained from the frequency shift in the O— stretching vibration, when the group being studied is substituted i a different ring from that carrying the OH, the substituent effectin the shift through an H-bond from the OH to an N atom between the two rings, which are part of the same molecule. Experimental results for various substituents show that the ortho and para constants are nearly the same. J.Hawgo

539.

2872. THE HEIGHT OF THE BARRIER HINDERING ROTATION NITROSODIMETHYLAMINE. M.Simonetta and S.Carrà.

Nuovo Cimento, Vol. 9, No. 5, 902-7 (Sept. 1, 1958).

This is calculated by a simple molecular orbital treatment, i the π-electron approximation. The σ-bond energies and non-bondi forces are also evaluated. Fair agreement with experimental results is obtained.

539.1

2873. A NEW BAND SYSTEM OF THE P_2 MOLECULE ANALOG OUS TO THE LYMAN—BIRGE—HOPFIELD BANDS OF N_2.

A.E.Douglas and K.Suryanarayana Rao.

Canad. J. Phys., Vol. 36, No. 5, 565-70 (May, 1958).

Five bands of a new band system of P_2 were photographed at high dispersion and analysed. The upper state of the system is a $^1\Pi_g$ state and lies lower than any previously known excited single state. The lower state of the new system is the ground state of P_2 and the analysis of the new bands has given improved constants fo this state. The new system appears to be the analogue of the Lyma Birge—Hopfield bands of N_2. The electron configuration of the low excited states of P_2 and of related molecules is discussed.

539.1

2874. SPIN ROTATIONAL CONSTANT OF H_2. G.E.Tauber.

Phys. Rev., Vol. 112, No. 3, 866-9 (Nov. 1, 1958).

The spin rotational constant of H_2 is calculated by considering the motion of the electrons in the presence of the two nuclei which are themselves permitted to move. The interaction is described b Breit's two-body Hamiltonian suitably generalized to this problem. The wave-function is obtained by the Born—Oppenheimer method of adiabatic approximation. Calculations are carried out for Wang's electronic wave function and up to first order in the expansion parameter give for the effective magnetic field due to rotation 23.6 G, i good agreement with the experimental result of 27.0 G.

539.19 : 535.33

ROTATIONAL AND VIBRATIONAL ANALYSIS OF THE Cl_2^+ MOLECULE. See Abstr. 2200

539.1

2875. ENERGY LEVELS OF POLYATOMIC MOLECULES.

S.D.Majumdar.

Proc. Phys. Soc., Vol. 72, Pt 4, 635-48 (Oct., 1958).

The mathematical theory of semi-rigid asymmetric top molecules is re-formulated by introducing a new set of operators for angular momentum. All matrix equations are thereby replaced by ordinary differential equations, and the necessity of solving a formi able secular equation for the determination of energy is dispensed with. An analytic expression for energy correct to the second orde can be obtained by the methods delineated here.

539.1

2876. ELECTRON SPIN RESONANCE IN TRANSITION METAL CHELATES. I. COPPER (II) BIS-ACETYLACETONATE.

A.H.Maki and B.R.McGarvey.

J. chem. Phys., Vol. 29, No. 1, 31-4 (July, 1958).

Electron spin resonance at 3.2 cm was observed from copper (in single crystals of copper (II) bis-acetylacetonate diluted to $\frac{1}{2}$ mole with palladium (II) bis-acetylacetonate at 77° K and 300° K. The parameters of the spin Hamiltonian are expressed in terms of the atomic orbital coefficients of molecular orbital wave-functions describing the electron hole in the orbital ground state and two excited states. Experimental determination of the spin Hamiltonian then results in expressions for the molecular orbital wave-functions. The results indicate that the in-plane sigma and pi bonding are appreciably covalent, whereas the out-of-plane pi bonding with the acetylacetonate ring is ionic. The hyperfine interaction may be expresse by a relation of the type $K^2g^2 = A^2 g_{\parallel}^2 \cos^2\theta + B^2 g_{\perp}^2 \sin^2\theta + 2C^2 g_{\parallel} g_{\perp} \sin\theta \cos\theta$, where C^2 increases with decreasing temperature. The appearance of the term in $\sin\theta \cdot \cos\theta$ is attributed to low symmetry crystal fields due to the crystallographic array, the main symmetry being determined by the molecule itself. A small amount of rhombic character was observed in the g tensor, but was not enough to make an accurate location of the g_x and g_y directions possible. For the purpose of analysis, the g factor is expressed in terms of the two principal values $g_{\parallel}$ and $g_{\perp}$ which do not vary between 77°K and 300°K to the accuracy of the determination.

539.19

2877. ELECTRON SPIN RESONANCE IN TRANSITION METAL CHELATES. II. COPPER (II) BIS-SALICYLALDEHYDE-IMINE.

A.H.Maki and B.R.McGarvey.

J. chem. Phys., Vol. 29, No. 1, 35-8 (July, 1958).

The electron spin resonance at 3.2 cm was observed for single crystals of copper(II) bis-salicylaldehyde-imine diluted to $\frac{1}{2}$ mole % with the corresponding nickel chelate. Analysis of the spectrum by methods given in the preceding abstract indicate that the sigma bonding and in-plane Π-bonding are appreciably covalent, whereas the out-of-plane π bonding is ionic. Hyperfine interactions in addition to that resulting from the copper nucleus were observed and shown to be attributable to interactions with the nitrogen nuclei adjacent to the copper ion and with the two protons bonded to the carbon atoms directly adjacent to the nitrogen atoms. The two protons bonded directly to the nitrogen atoms do not contribute to the hyperfine interactions. Bonding information obtained from the magnitude of the hyperfine interaction due to the nitrogen nucleus agrees with that obtained from the g tensor and hyperfine interaction of the copper nucleus. In addition structural information about nickel(II) bis-salicylaldehyde-imine is obtained. The Ni–O distance is 1.92 ± 0.07 A while the Ni–N distance is 1.94 ± 0.05 A. The angle between these bonds is found to be 93 ± 3°.

539.19

2878. PARAMAGNETIC RESONANCE OF VANADYL ETIOPORPHYRIN I. D.E.O'Reilly.

J. chem. Phys., Vol. 29, No. 5, 1188-9 (Nov., 1958).

Electron spin resonance spectra are given for the 3d electron in the vanadyl chelate compound, vanadyl etio-porphyrin I in benzene and in high viscosity oil. The results are interpreted in terms of an axially symmetric spin Hamiltonian which includes hyperfine interaction with $V^{51}(I = 7/2)$. In benzene the rotation of the complex gives the isotropic parameters $g_0 = \frac{1}{3}(g_{\parallel} + 2g_{\perp}) = 1.974 \pm 0.002$ and $a = \frac{1}{3}(A + 2B) = 0.0089\ \text{cm}^{-1}$. In the oil the correlation time is so long that an essentially static complex is observed leading to values $g_{\parallel} = 1.948 \pm 0.009$ and $g_{\perp} = 1.987 \pm 0.005$, $(A) = 0.0159\ \text{cm}^{-1}$ and $(B) = 0.0052\ \text{cm}^{-1}$, A and B same sign. The results are related to the optical absorption spectra. In single crystal material dipole–dipole broadening predominates.

J.G.Powles

539.19

2879. F^{19} HYPERFINE INTERACTION IN THE PARAMAGNETIC RESONANCE SPECTRUM OF Mn^{++} IONS IN ZnF_2.

A.Mukherji and T.P.Das.

Phys. Rev., Vol. 111, No. 6, 1479-82 (Sept. 15, 1958).

The observation of a predominantly isotropic fluorine hyperfine interaction in the paramagnetic resonance of Mn^{++} ions dissolved in a ZnF_2 crystal is interpreted in terms of the contact interaction of the unpaired d electrons of the Mn^{++} ion at the fluorine nucleus. The distortion produced in the free-ion orbitals of the Mn^{++} 3d electrons due to the electrons of the F^- ion is considered. The calculated value of the isotropic hyperfine interaction constant is 10 oersteds, which is about half the experimental value of 19 oersteds. The quadrupole interaction of the Mn^{++} d electrons with the crystalline field gradient, calculated on the point charge model, is found to produce a very small change in the theoretical value. The principal causes which contribute to the quantitative disagreement between the theoretical and the experimental values are also discussed.

539.19

2880. DEUTERIUM ISOTOPE EFFECT IN PROTON NUCLEAR RESONANCE SPECTROSCOPY. G.Van D. Tiers.

J. chem. Phys., Vol. 29, No. 4, 963-4 (Oct., 1958).

The protons in the $-CH_2D$ group of α-deuterotoluene were found to be 0.015 ± 0.002 p.p.m. more shielded than those in the $-CH_3$ group of deuterium free toluene or of p-deuterotoluene. The direction of the isotope shift indicates a greater electron donating power for deuterium than for hydrogen.

J.M.Baker

539.19

2881. ANISOTROPY OF THE C^{13} CHEMICAL SHIFT IN CALCITE.

P.C.Lauterbur.

Phys. Rev. Letters, Vol. 1, No. 9, 343-4 (Nov. 1, 1958).

An anisotropic chemical shift of the C^{13} nuclear magnetic resonance was observed in a single crystal of calcite. The low abundance of magnetic nuclei gives very narrow lines; 20 milligauss was observed. The shift, expressed as a fraction of the resonant field, varies between 58.4×10^{-6} and -16.6×10^{-6} with the external magnetic field parallel and perpendicular to the axis of the CO_3^{--} radical.

J.M.Baker

539.19

2882. INVESTIGATION OF RELAXATION PROCESSES IN SEVERAL FLUORINE COMPOUNDS OF CARBON. V.S.Grechishkin.

Zh. eksper. teor. Fiz., Vol. 35, No. 2(8), 364-6 (1958). In Russian.

A study is made of the influence of the tensor of chemical displacements on the relaxation time of fluorine nuclei. The theory is compared with the experiment. It is found that the difference in the relaxation times of the fluorine nucleus and a proton in the same molecule depends on the presence of nuclei of a different halogen.

539.19

2883. CONFIGURATION INTERACTION IN THE HYDROGEN FLUORIDE MOLECULE. A.M.Karo and L.C.Allen.

J. Amer. Chem. Soc., Vol. 80, No. 17, 4496-9 (Sept. 5, 1958).

A self-consistent field molecular orbital (SCF MO) calculation of the electronic structure of HF in the ground state and at the observed internuclear separation was made. The MO's were approximated as linear combinations of atomic orbitals (LCAO's) and all electrons and the exact Hamiltonian were used. Both a single determinant MO and a configuration interaction (CI) treatment were carried out with single exponential Slater AO's as basis functions. The parameters for the single exponential basis set were chosen to be identical to those used by Duncan (Abstr. 6363/1955, 8756/1957) and comparison is made with his work and that of others. The results including CI give 34.8% of the observed binding energy and a dipole moment of +0.6938 Debye unit (experimental value = +1.74 D).

539.19

2884. APPLICATION OF THE SELF CONSISTENT FIELD METHOD TO THE MOLECULES CIS AND TRANS DICHLOROETHYLENE AND TETRACHLOROETHYLENE.

G.Favini and M.Simonetta.

Nuovo Cimento, Vol. 9, No. 6, 1058-67 (Sept. 16, 1958). In Italian.

Ionization potential, π–π transition energy, dipole moment and bond length values are calculated and discussed.

539.19

2885. DETERMINATION OF MOLECULAR STRUCTURES FROM GROUND STATE ROTATIONAL CONSTANTS. C.C.Costain.

J. chem. Phys., Vol. 29, No. 4, 864-74 (Oct., 1958).

Kraitchman has shown that a single isotopic substitution on an atom is sufficient to determine directly the coordinates of that atom with respect to the principal axes of the original molecule. Kraitchman's formulae represent exact solutions of the equations for the equilibrium moments of inertia. However, the effects of the zero-point vibrations are such that the coordinates obtained by substitution from the ground state moments of inertia I_0 are systematically less than r_0. These coordinates are here called r (substitution) or r_s, and it is found that $r_s \cong (r_0 + r_e)/2$, and $I_s = \sum_i m_i r_{si}^2 \cong (I_0 + I_e)/2$.

In the usual method of solution, the coordinate of one atom is determined from the equation for I_0, and therefore the difference $I_0 - I_S$ must be made up by this one coordinate. This introduces a large error in the structures normally determined from ground state constants, and results in variations of 0.01 A in structures determined from different sets of isotopic species. If instead, the structure is obtained only from the r_s coordinates and no attempt is made to reproduce the I_0 values, the structure is virtually independent of the isotopic species used in the determination. The variation in the structures obtained from different sets of isotopic species appears to depend only on the uncertainties in the rotational constants. In addition, the accuracy is independent of the mass of the substituted atom, and therefore H atoms are located just as accurately as the heavier atoms. The r_s structures of HCN, N_2O, OCS, CH_3CCH, CH_3CN, CH_3NC, and the methyl halides are determined by the isotopic substitution method. For the first three molecules comparisons can be made with equilibrium data, and it is found that the r_s bond lengths are no more than 0.002 A greater than the r_e. The primary interest in the other molecules studies is in the structure of the methyl group. The anomalous separation of the H and D coordinates previously found is readily explained and does not appear in the r_s structures. The consistency of the results is such that comparisons between molecules can be made with confidence.

539.19

2886. STRUCTURE OF POTASSIUM HYDROGEN MALEATE BY NEUTRON DIFFRACTION. S.W.Peterson and H.A.Levy.
J. chem. Phys., Vol. 29, No. 4, 948-9 (Oct., 1958).

This study confirms the presence of a short, strong H bond and shows that it is at least statistically symmetrical. The temperature factors support the hypothesis that the H atom is actually equidistant from the two O atoms. J.Hawgood

539.19

2887. THE THEORY OF COLLISION-INDUCED ABSORPTION IN HYDROGEN AND DEUTERIUM. F.R.Britton and M.F.Crawford.
Canad. J. Phys., Vol. 36, No. 6, 761-83 (June, 1958).

Collision-induced absorptions in the 1-0 vibrational band of hydrogen and of deuterium are calculated by considering interactions during binary collisions. The induced dipole moment, μ, of an interacting molecule-pair is derived by combining a moment, μ_a, resulting from overlap forces, with a moment, μ_q, due to the interactions of permanent molecular quadrupole moments. μ_a consists of two additive parts, an indirect part calculated by van Kranendonk and Bird (1951) and a direct part calculated in this paper. μ_q is calculated in two different ways: (a) theoretically and (b) semiempirically. Absorption coefficients are evaluated for temperatures 296°K and 80°K. For H_2 at 296°K the total integrated coefficient obtained by using procedure (a) is 8.6% smaller and by using (b) is 8.2% larger than the experimental value. The experimental ratio of the coefficients of the Q and S branches is in much better agreement with (b) than (a). For T = 80°K the experimental value of the total integrated coefficient is only 61% of that calculated by (b). The good agreement between calculated and experimental values of absorption coefficients at room temperature suggests that at low temperatures the classical distribution function used in this paper must be replaced by the quantal pair distribution function. Experimental data for D_2 are not available.

539.19

2888. INTERACTION ENERGIES OF NEXT-NEAREST NEIGHBORS. T.L.Allen.
J. chem. Phys., Vol. 29, No. 4, 951-2 (Oct., 1958).

The dependence of C—C and S—S bond energies on chain length and on extent of branching may be explained by van der Waals interaction of C (or S) atoms which are next-nearest neighbours. The interaction energies of these next-nearest neighbours are given for a series of straight chain and branched saturated hydrocarbons, sulphanes and S_8. G.I.W.Llewelyn

539.19 : 537.56

CAPTURE OF SLOW ELECTRONS BY VARIOUS MOLECULES.
See Abstr. 2450

539.19 : 537.226.2

2889. ON THE THEORY AND MEASUREMENT METHOD OF THE RELAXATION REGION OF DIPOLAR MOLECULES.
E.Ledinegg, P.Urban and L.Breitenhuber.
Acta phys. Austriaca, Vol. 11, No. 2, 147-92 (1957). In German.

The measurement of permanent dipole moments of liquids is based on the physical relation between dielectric constant and the molecular structure of the experimental liquid. The work on organic liquids described extends that reported by Ledinegg, Urban and Reder (Abstr. 287/1951) and analyses the measuring methods for dielectric constant ϵ and dielectric loss. Results agree closely with values of ϵ obtained from infrared and other measurements.
C.A.Hogarth

539.19

2890. VIBRATIONAL RELAXATION TIMES OF A NUMBER OF POLYATOMIC GASES DERIVED FROM MEASUREMENTS OF ACOUSTIC ABSORPTION. P.D.Edmonds and J.Lamb.
Proc. Phys. Soc., Vol. 72, Pt 6, 940-8 (Dec., 1958).

The authors have described in a previous paper (Abstr. 923/1958) a method for deriving the acoustic absorption coefficient of gases from measurements of the decay time of a cylindrical resonator containing the gas in question. This technique has been applied to determine the relaxational contribution to the absorption at frequencies well below the dispersion region for a number of gases. The information is then used to evaluate the relaxation times for deactivation of the vibrational energy and results are given for boron trifluoride, cyclopropane, methane, methyl chloride, carbon tetrafluoride, ethylene, acetylene, 1,3-butadiene and 1,-2-dichloro tetrafluoroethane. Agreement is found with relaxation times evaluated from ultrasonic velocity measurements in cases where comparison can be made.

539.19 : 536.6

2891. INTERNAL ROTATION AND THE SPECIFIC HEAT OF SUNDRY POLYMERS AT LOW TEMPERATURES.
I.V.Sochava and O.N.Trapeznikova.
Vestnik Leningrad. Univ., (1958), No. 16, Ser. Fiz. Khim., No. 3, 65-72. In Russian.

Specific heat curves are drawn for methylmethacrylate polym and monomer and for polystyrene over temperature range 60-200° Similar anomalies are found for all three consisting of an additiona maximum on the curve. This is interpreted as due to excitation of rotational vibrations of the side radicals. C.R.S.Mande

539.

2892. FORMATION OF HYDROGEN MESIC MOLECULES.
Ya.B.Zel'dovich and S.S.Gershtein.
Zh. eksper. teor. Fiz., Vol. 35, No. 3(9), 649-54 (1958). In Russian

An effective mechanism of formation of hydrogen mesic molecules is indicated. It consists of a transition from the S-wave in th repulsion state to the rotational level K = 1 with transfer of the energy to a conversion electron. The calculations yield a value $\sim 1.5 \times 10^6$ sec^{-1} for the probability of formation of a mesic molecule $(pp)^+_\mu$ in liquid hydrogen. The process under consideration is significant for catalysis of the p + d nuclear reaction and also for operation of the $\mu^- + p \rightarrow n + \nu$ process in liquid hydrogen.

SOLID-STATE PHYSICS

539.2 : 621.38

2893. SOLID STATE PHYSICS. P.T.Landsberg.
Nature (London), Vol. 182, 567-8 (Aug. 30, 1958).

This conference was part of the activities associated with the Brussels Universal Exhibition, and the papers presented will be published in full. This report seeks to indicate the scope of the meeting, and it presents a few specific results reported at the meeting. Basic solid state physics and applications to electronics and telecommunications received main emphasis. Selected headings ar transport properties, magnetic effects, surfaces, transistors, phosphors, electroluminescence, ferrites, noise, masers, etc.
P.T.Landsber

539.

2894. THEORY OF THE ANHARMONIC PROPERTIES OF SOLID
E.A.Stern.
Phys. Rev., Vol. 111, No. 3, 786-97 (Aug. 1, 1958).

A theory is presented with which one can calculate the anharmonic properties of solids such as thermal expansion, temperature dependence of elastic constants, dependence of elastic constants under stresses, and the deviation of the specific heat from the Dulong—Petit law at high temperatures. The theory is applied to sodium under the assumption of a special force interaction between nearest neighbours only. In the approximation used, three parameters enter. The three parameters are obtained from experiment measurements of the elastic constants near 0°K, the temperature dependence of the compressibility, and the thermal expansion. The the variation of the volume with pressure and the deviation of the specific heat from the Dulong—Petit law at high temperatures are calculated. A satisfactory agreement with experiment is obtained. Another prediction of the theory, that the temperature derivative of the compressibility is proportional to the specific heat, also shows satisfactory agreement with the experimental measurements for sodium.

539.

2895. THEORY OF SOLID Ne, A, Kr, AND Xe AT 0°K.
N.Bernardes.
Phys. Rev., Vol. 112, No. 5, 1534-9 (Dec. 1, 1958).

A quantum-mechanical variational technique is applied to an Einstein model of a solid, and the heats of sublimation and equation of state of solid Ne, A, Kr, and Xe are calculated at 0°K. Mie—Lennard-Jones 6-12 potentials appropriate to the gas-phase data ar used throughout, and the importance of quantum-mechanical effects is discussed; in general, good agreement with experiment is obtained. From the theoretical zero-point energies equivalent Debye temperatures, θ, are calculated, and from the dependence of these θ on volume, Grüneisen constants are computed in good agreement with experiment. Theoretical compressibility curves (at 0°K) are presented, and compared with the available experimental data; in the case of Ne, the only substance for which high-pressure data are available, the agreement is rather good up to 20 katm.

539.2

2896. LATTICE DYNAMICS OF HEXAGONAL CLOSE-PACKED METALS. III.

L.J.Slutsky.

J. chem. Phys., Vol. 29, No. 5, 1191-2 (Nov., 1958).

For Pt II, see Abstr. 1305 (1958). By the method previously used for Mg, frequency spectra are calculated with different values of the force constants, such as may apply to less ideally packed metals. Plots of the equivalent Debye temperature versus temperature are also given, with some experimental points for Ti, Zr, Zn and Cd. Agreement is poor. L.Pincherle

539.2

2897. NORMAL MODES OF GERMANIUM BY NEUTRON SPECTROMETRY.

B.N.Brockhouse and P.K.Iyengar.

Phys. Rev., Vol. 111, No. 3, 747-54 (Aug. 1, 1958).

The frequency wave-number relations of the lattice vibrations in germanium which propagate in the symmetric [100] and [111] directions (and some results in other directions) were obtained by studying energy distributions of neutrons scattered by a germanium single crystal. The characters of the phonons were ascertained from the intensities and positions of the neutron groups in the reciprocal lattice. The methods are discussed. The results cannot be fitted by simple models using the Born—von Kármán theory, but explain satisfactorily the specific heat. The far-infrared spectrum of germanium can be interpreted as combination bands in terms of these results.

539.2

2898. LATTICE VIBRATIONAL SPECTRA OF Si AND Ge.

H.Cole and E.Kineke.

Phys. Rev. Letters, Vol. 1, No. 10, 360 (Nov. 15, 1958).

A programme, based on the Born—von Kármán theory of lattice vibrations, was written for an I.B.M. 704 and used to calculate the lattice vibrational spectrum of silicon and germanium. The spectrum of germanium was determined by using the experimentally measured dispersion curves for waves travelling in two directions (Brockhouse and Iyengar, preceding abstract) using neutron scattering, and the spectrum of silicon by using the force constants derived from X-ray scattering experiments (A.Learn, thesis, Massachusetts Institute of Technology, 1958, to be published). R.Bullough

539.2

2899. NONEQUILIBRIUM PHONON DISTRIBUTION IN METALS.

D.I.Paul.

Phys. Rev., Vol. 111, No. 4, 1086-92 (Aug. 15, 1958).

The effect of a nonequilibrium phonon distribution on some of the transport properties of metals is calculated in the presence of electric and thermal currents and a magnetic field. It is shown that the lattice heat current contains an additional term not found in the literature which is equal in magnitude to the terms usually retained, and that this term represents the contribution from the nonequilibrium part of the electron energy distribution. Thus, the heat current carried by the lattice in metals is dependent on the magnitude of the electron current. Further, the effect of electron phonon scattering caused by a nonequilibrium phonon distribution on the Ettingshausen and Ettingshausen—Nernst coefficients is shown to be insufficient to explain the anomalous behaviour of these coefficients for metals.

539.2

2900. MOMENTUM OF PHONONS. II.

G.Süssmann.

Z. Naturforsch., Vol. 13a, No. 1, 1-6 (Jan., 1958). In German.

For Pt I, see Abstr. 3048 (1956). Continues the investigation of the de Broglie relationship for the phonon, and discusses the relationships between the momentum of the lattice and the pseudo-momentum of its sonic field as follows: (a) interaction with an electron; (b) transition from the linear, periodically continued chain to a three-dimensional lattice with surface effects; (c) optical characteristic vibrations of the lattice; (d) the torsional momentum. F.Lachman

539.2

2901. ON THE KINETIC EQUATIONS FOR A SYSTEM OF PARTICLES INTERACTING WITH LATTICE OSCILLATIONS.

Yu.L.Klimontovich and S.V.Temko.

Zh. eksper. teor. Fiz., Vol. 35, No. 5(11), 1141-7 (1958). In Russian.

A deduction of the kinetic equations for the distribution functions of electrons and crystal lattice oscillations is presented. In the case of homogeneous space the equation for the electron distribution function is identical with the kinetic equation in Bloch's electric conductivity theory. An equation for the lattice oscillations was derived and expressions for the frequency and damping decrement of the oscillations were found.

539.2

2902. POTENTIAL OF A CRYSTAL POINT LATTICE.

I.V.Abarenkov.

Vestnik Leningrad. Univ., (1958), No. 16, Ser. Fiz. Khim., No. 3, 5-13. In Russian.

The point charge cubic lattice is considered and its potential derived in a series of cubic harmonics around any point charge. Useful tables of parameters are given and an analytical expression obtained for some first coefficients of this series. C.R.S.Manders

539.2

2903. NOTE ON THE MOTION OF ELECTRONS AND HOLES IN PERTURBED LATTICES.

R.R.Haering.

Canad. J. Phys., Vol. 37, No. 1, 47-52 (Jan., 1959).

A new set of orthogonal, localized functions is discussed. The functions bear the same relation to the functions of Luttinger and Kohn as the Wannier functions bear to the Bloch functions. The new functions are used to give an alternative derivation of the effective mass equation.

539.2

2904. SELF-DIFFUSION AND ELECTRICAL CONDUCTIVITY IN SILVER BROMIDE.

A.S.Miller and R.J.Maurer.

J. Phys. Chem. Solids, Vol. 4, No. 3, 196-200 (1958).

The ionic conductivity and the self-diffusion coefficient of silver have been measured in silver bromide and in silver bromide—cadmium bromide single crystals between 20 and 380°C. There exists a range of temperature for crystals containing cadmium within which the ratio of the conductivity to the self-diffusion coefficient has the value of 1.25 which is predicted for the vacancy mechanism of diffusion by the Einstein relation as modified by the Bardeen—Herring correction. This result is in agreement with the assumption that divalent cadmium ions replace monovalent silver ions in the crystal lattice and introduce an equal number of silver-ion vacancies. These excess vacancies reduce the concentration of interstitial silver ions to a negligible quantity through the operation of the mass-action law. Under these conditions diffusion occurs only by the vacancy mechanism. Conductivity and diffusion data obtained with pure silver bromide crystals are in fair agreement with the more extensive data of Friauf (Abstr. 3754/1957).

539.2 : 537.311.33

2905. ON THE EFFECTIVE MASS OF ELECTRONS IN CRYSTALS.

W.Martienssen.

Naturwissenschaften, Vol. 44, No. 21, 551-4 (1957). In German.

The concept of effective mass is discussed and the following three methods of measuring it in semi-conductors are reviewed: cyclotron resonance, splitting of the optical absorption spectrum by a magnetic field, and study of hydrogen-like spectra associated with impurities. B.T.M.Willis

539.2

2906. ENERGY BANDS IN SOLIDS — THE QUANTUM DEFECT METHOD.

H.Brooks and F.S.Ham.

Phys. Rev., Vol. 112, No. 2, 344-61 (Oct. 15, 1958).

This paper describes a procedure for the calculation of electron energy bands in certain solids from spectroscopic data for the corresponding free atom. This method is an improved version of one used by Kuhn and Van Vleck to calculate the energy bands of sodium, potassium, and rubidium. It avoids explicit construction of a one-electron potential to represent the interaction between the valence and core electrons. It is assumed that the interaction between a valence electron and an ion in the crystal is approximately the same as in the isolated atom. If the interaction is accurately represented by a Coulomb potential outside the ion core, one may express solutions of the radial differential equation in this region as linear combinations of standard Coulomb functions. The combination corresponding to the solution which is well-behaved at the nucleus involves a coupling constant which depends upon the ion potential through a parameter that is a slowly varying function of the energy. At an eigenvalue this parameter can be evaluated from the quantum defect. Hence if the eigenvalue spectrum is known, one may obtain this parameter by extrapolation for arbitrary nearby energies, and the regular solution of the radial equation is consequently determined explicitly, outside the core. This is sufficient information for the calculation of energy bands with available techniques. An approximate formula is established for the ratio of the amplitude of the wave function near the nucleus to its value at a point outside the core. For an s-function this relation involves only the nuclear charge, standard Coulomb functions, and the aforementioned parameter derived from spectroscopic data. It therefore provides a convenient means of calculating P_F and P_A, the squared amplitudes at the nucleus appropriate to the Knight shift and the atomic hyperfine splitting, respectively. In the latter case the result is identical with a formula given by Fermi and Segrè, which gives reasonable agreement with experiment. Arguments are presented in support of the thesis that the quantum defect method takes very general account of exchange and correlation interactions between the valence electron and core electrons. Relativistic effects, including spin—orbit coupling, are also included naturally. Also discussed are the modifications in the method to take into account deviations of the ion or crystal potential outside the core from Coulomb form. Tables of the essential data, including improved polarization corrections, are given for the alkali metals.

539.2

2907. DEVIATIONS FROM STOICHIOMETRY IN BINARY IONIC CRYSTALS. R.F.Brebrick.

J. Phys. Chem. Solids, Vol. 4, No. 3, 190-5 (1958).

A grand partition function was constructed for a pure uni-univalent ionic crystal which can deviate from stoichiometric composition by the inclusion of lattice vacancies. A departure from earlier statistical treatments is made in assuming that the valence electrons distribute themselves over the energy levels of a typical semiconductor electronic band structure. Each vacancy in the cation (anion) sublattice of the crystal has associated with it an acceptor (donor) level in the band structure with a maximum occupancy of one and a degeneracy of two. The interaction between deviations from stoichiometry and the electronic band structure is assumed to be entirely accounted for by the introduction or removal of these donor and acceptor levels. The equilibrium distribution functions obtained are put in the form of mass-action-law expressions. However, the equilibrium constants for those mass-action-law expressions which contain the concentrations of conduction band electrons or valence band holes are not true thermodynamic quantities. These constants depend on the Fermi level and therefore on the deviation from stoichiometry. This dependence disappears when the Fermi level is in the forbidden gap and a few units of kT away from the conduction and valence bands. The chemical potentials of the crystal components are obtained. These agree simultaneously with the expressions used to date only when the Fermi level is between the donor and acceptor levels and a few units of kT away from them.

539.2

2908. OXYGEN BAND IN MAGNESIUM OXIDE. J.Yamashita.

Phys. Rev., Vol. 111, No. 3, 733-5 (Aug. 1, 1958).

The approximation of tight binding is employed to determine the width and the depth of the oxygen band in MgO. A width of about 9 eV and a depth of about 7.6 eV are obtained. The agreement between theory and experiment seems to be fairly good.

539.2

2909. SPLITTING OF ATOMIC TERMS WITH INTEGRAL TOTAL ANGULAR MOMENTA IN A MAGNETIC CRYSTAL. B.A.Tavger.

Zh. eksper. teor. Fiz., Vol. 35, No. 2(8), 467-73 (1958). In Russian.

A method is proposed for determination of degeneracy due to magnetic symmetry. It is employed in an analysis of the splitting of the atomic terms in a magnetic crystal for all cases of magnetic symmetry assuming that the total angular momentum of the atom is an integer. The results are compared with the splitting of atomic terms in a nonmagnetic crystal. It is found that the magnetic interaction in the crystal does not always completely lift the degeneracy of the energy levels in the atom. It is shown that the results obtained can be applied to determine the splitting of the terms of atoms of a nonmagnetic crystal, if the latter is located in a magnetic field.

539.2

2910. CORRELATION ENERGY OF AN INHOMOGENEOUS ELECTRON GAS. D.A.Kirzhnits.

Zh. eksper. teor. Fiz., Vol. 35, No. 5(11), 1198-208 (1958). In Russian.

The influence of non-uniform distribution of particles on the electron correlation energy is investigated. It is found that the influence is so large that the corresponding expressions obtained on the basis of the uniform distribution model are not valid for real systems. The main part of the electron correlation energy in a crystal lattice (neglecting interaction with oscillations of the latter) was found for large pressures, low temperatures and large nuclear-charge values. Estimates of the correlation energy of uncompressed matter are given.

539.2 : 530.162

CORRELATION ENERGY OF A FREE ELECTRON GAS. See Abstr. 2107

539.2 : 535.399

MUTUAL CORRELATION OF ELECTRONS IN METAL OPTICS. See Abstr. 2241

539.2 : 539.14

THE QUANTUM-MECHANICAL MANY-BODY PROBLEM IN ELECTRON GASES. See Abstr. 2675

539.2 : 539.12

LIFETIME OF POSITRONIUM IN SOLIDS. See Abstr. 2582

539.2 : 539.12

EXISTENCE OF POSITRONIUM IN SOLIDS. See Abstr. 2584

539.2

2911. OBSERVATIONS OF DISLOCATIONS IN IRON WHISKERS. R.V.Coleman.

J. appl. Phys., Vol. 29, No. 10, 1487-92 (Oct., 1958).

The etching of iron whiskers in picral and nital etchants was studied and etch-pit configurations in certain areas of as-grown whiskers were observed. Dislocations introduced by plastic deformation of the whisker were investigated and arrays of dislocations produced by annealing the deformed whiskers were studied. Whiskers with axes in [100], [110], and [111] directions have been used in these experiments.

539.2

2912. ELECTRON THEORETICAL INVESTIGATION OF DEFECTS IN METALS. V. GENERAL THEORY OF THE EFFECTS OF LATTICE DEFECTS ON THE TRANSPORT PROCESSES IN METALS. H.Bross and A.Seeger.

J. Phys. Chem. Solids, Vol. 4, No. 3, 161-76 (1958). In German.

For Pt IV see Abstr. 1477 (1957). The present paper treats the application of the Kohler—Enskog variational principle to the scattering of conduction electrons by lattice defects in as general a way as seems possible. Particular emphasis is laid on those cases (which at present cannot be dealt with by other methods) in which the relaxation time tensor has more than one essential component. The technique allows one to calculate the electrical and thermal residual resistivity at low temperatures, and the electrical resistivity, thermal resistivity and thermoelectric power due to defects at temperatures above the Debye-temperature. Deviations from Matthiessen's rule and the connection with the anisotropy of the scattering centres are discussed in detail.

539.2

2913. A THEORETICAL CALCULATION OF THE RELAXATION OF ATOMS SURROUNDING A VACANCY IN THE BODY-CENTERED CUBIC LATTICE. L.A.Girifalco and J.R.Streetman.

J. Phys. Chem. Solids, Vol. 4, No. 3, 182-9 (1958).

The extent of relaxation of atoms surrounding a vacancy in body-centred crystals was computed, assuming an inverse-power pairwise potential acting between atoms in the crystal. Detailed calculations for a 5—7 law were made, using an I.B.M. 650 type electronic computer, which showed that the extent of relaxation was 5.05 per cent for the nearest neighbours and 1.12 per cent for the second-nearest neighbours. Approximate calculations for other potential laws showed that the relaxation is of the order of 3—6 per cent for potential laws ranging from a 4—6 to a 7—12 type. The energy of vacancy formation in a body-centred lattice whose atoms interact according to the 5—7 potential was found to be 80.1 per cent of the energy of sublimation. It is concluded from this study that the concept of a relaxion as a highly relaxed disorded structure is probably not correct in body-centred crystals whose atoms interact according to an inverse-power potential.

539.2

2914. DIRECT OBSERVATION OF DISLOCATIONS IN GRAPHITE.

A.Grenall.

Nature (London), Vol. 182, 448-50 (Aug. 16, 1958).

Thin flakes of natural graphite were observed in the electron microscope. Single dislocations, sub-boundaries and dislocation networks were observed. Under the influence of the electron beam, dislocations were observed to move, to bow around obstacles, and were sometimes also nucleated at edges. Fast and slow motions of the dislocations were distinguished, the former being attributed to glide and the latter to climb. J.W.Menter

539.2

2915. THERMAL PROPERTIES OF MOBILE DEFECTS.

A.Granato.

Phys. Rev., Vol. 111, No. 3, 740-6 (Aug. 1, 1958).

Using simplified models, calculations are made for the contribution of mobile dislocations and small-angle boundaries to the specific heat and thermal resistivity of crystals. The specific heat is found to be proportional to T and T^2, and the lattice resistivity approximately to T^{-n} (where n lies between 3 and $\frac{7}{2}$ for the usual range of measurements) and T^{-5} for mobile dislocations and mobile small-angle boundaries, respectively, over a range of low temperatures, but eventually both go to zero in the limit as the temperature approaches zero. The magnitudes of the effects are such that although the contribution of dislocations to the specific heat of some pure cold-worked nonconductors and superconductors may be measurable, that from small-angle boundaries is not. The effect of dislocations on the thermal resistivity is large and should compete with boundary scattering for temperatures of the order of 10^{-2} of the Debye temperature, with dislocation densities of the order of $10^7\,\mathrm{cm}^{-2}$ in specimens of a few millimetres in diameter. The predicted temperature dependence is in agreement with recent measurements on superconducting lead at low temperatures. At present a contribution from mobile boundaries to the thermal resistivity is not excluded as a possibility.

539.2 : 537.311

2916. QUENCHED IMPERFECTIONS AND THE ELECTRICAL RESISTIVITY OF ALUMINUM AT LOW TEMPERATURES.

W.DeSorbo.

Phys. Rev., Vol. 111, No. 3, 810-12 (Aug. 1, 1958).

The electrical resistivity of a high-purity aluminium specimen, having different concentrations of "quenched-in" lattice defects, is reported for the temperature region 1-20°K. For small and different concentrations of structural impurities, the resistivity follows Matthiessen's rule. The exponential constant, n, in the equation $\rho = \rho_i + AT^n$, is equal to 2.7 for the sample in a well-annealed state. This number increases slightly with an increase in defect concentration.

539.2 : 539.37

2917. INFLUENCE OF DEFORMATIONS ON OSCILLATION EFFECTS IN METALS AT LOW TEMPERATURES.

A.M.Kosevich.

Zh. eksper. teor. Fiz., Vol. 35, No. 1(7), 249-53 (1958). In Russian.

The effect of elastic deformation on the properties of the electron gas in a metal is considered. It is shown that in the presence in the metal of electron groups with significantly different numbers of electrons, the de Haas—van Alphen effect is very sensitive to deformations of the metal. An explanation is given of the oscillations of thermodynamic quantities of the metal in a constant magnetic field produced by variations of external pressure.

539.2

2918. SOME LOW-TEMPERATURE PROPERTIES OF THE R, M, AND N CENTERS IN KCl AND NaCl.

W.D.Compton and C.C.Klick.

Phys. Rev., Vol. 112, No. 5, 1620-3 (Dec. 1, 1958).

Temporary changes in the absorption spectrum of a coloured NaCl crystal can be produced at 77 and 4°K by irradiating the crystal with a strong auxiliary light. The changes in the absorption spectrum indicate that the R, M, and N centres are not randomly distributed but are located near each other. It is concluded that previous arguments based upon less complete observations are not valid and that one cannot decide from this type of experiment whether the R_1 and R_2 bands arise from transitions in two distinct centres or from two transitions in the same centre. Measurements of the degree of polarization of the emission excited with R_1- or R_2-band light indicate that the concentration of other centres probably affects this number. It is concluded that this measurement may not determine the symmetry of these centres. Measurements of the temperature dependence of the half-widths of the absorption and emission bands of the M centre indicates that the optical transition is primarily influenced by local interactions of the centre with neighbouring ions and not by interactions with the long-range phonons of the lattice.

539.2 : 535.37

2919. ENERGY TRANSFER IN LUMINESCENT MINERAL CRYSTALS.

D.Curie.

J. Chim. phys., Vol. 55, No. 9, 607-12 (Sept., 1958). In French.

Modes of energy transfer are divided into processes which can occur independently of a crystalline structure (re-absorption, electron exchange and resonance transfer), and those characteristic of the crystalline state (hole and exciton transfer). J.Franks

539.2

2920. THE THEORY OF EXCITONS AND THEIR ROLE IN THE TRANSFER OF ENERGY IN THE SOLID STATE.

H.Haken.

J. Chim. phys., Vol. 55, No. 9, 613-20 (Sept., 1958). In French.

The stationary state of the exciton is described. Selection rules are given for optical transitions for large-orbit excitons. A quantitative theory is given of the energy transfer by excitons and compared with energy transfer by quantum resonance. J.Franks

539.2 : 535.37

2921. ENERGY TRANSFER BY EXCITONS IN PURE CADMIUM SULPHIDE.

E.Grillot.

J. Chim. phys., Vol. 55, No. 9, 642-9 (Sept., 1958). In French.

A study of the green emission spectrum of CdS at 4°K, including measurements of polarization and of the Zeeman effect, and a comparison with the absorption spectrum, support the view that the emission is due to the annihilation of excitons. Energy transfer mechanisms by excitons are discussed. J.Franks

539.2 : 535.37 : 535.343

2922. EXCITON SPECTRA AND POLYMORPHISM OF SILVER IODIDE.

G.Perny.

J. Chim. phys., Vol. 55, No. 9, 650-3 (Sept., 1958). In French.

Thin layers of AgI of the different polymorphic types were prepared. Each type has characteristic absorption and photoluminescence spectra. Some of the spectra form hydrogen-like series, which are attributed to excitons. J.Franks

539.2 : 535.37 : 535.343

2923. EXCITONS IN BENZENE AND NAPHTHALENE CRYSTALS AT 20°K.

A.Zmerli and H.Poulet.

J. Chim. phys., Vol. 55, No. 9, 654-6 (Sept., 1958). In French.

Some absorption and luminescence lines in the spectra of C_6H_6, C_6D_6, $C_{10}H_8$ and $C_{10}D_8$ at 20°K, are ascribed to exciton transitions. J.Franks

539.2 : 535.345

2924. INFRARED ABSORPTION BY SODIUM CHLORIDE-TYPE LATTICES.

H.B.Rosenstock.

J. Phys. Chem. Solids, Vol. 4, No. 3, 201-5 (1958).

A computation is made of the frequencies at which the vibrational motion of the atoms in a crystal of the NaCl-type structure should produce absorption. Four subsidiary frequencies are found in addition to the classical "limiting frequency". The results are evaluated for those alkali halides for which compressibility and lattice distance are known; it is found that experimental absorption measurements made on thin evaporated films are fitted more closely by some of the subsidiary frequencies than by the classical limiting frequency.

539.2

2925. BAND STRUCTURE AND INFRARED ABSORPTION OF GRAPHITE.

W.S.Boyle and P.Nozières.

Phys. Rev., Vol. 111, No. 3, 782-5 (Aug. 1, 1958).

The infrared optical properties of graphite single crystals were calculated from a model of the band structure developed by group theory. These calculations were compared with measurements of the emissivity and reflection coefficient of single crystals. At short wavelengths interband effects predominate; from the experimental results the maximum splitting of the π bands at a corner of the zone was set at 0.56 eV. At longer wavelengths the intraband contributions become large, giving rise to plasma effects in the neighbourhood of 25 microns. This gives an approximate value of the band overlap lying between 0.04 and 0.01 eV.

539.2 : 535.343

INFRARED STUDIES ON POLYMORPHS OF SILICON DIOXIDE AND GERMANIUM DIOXIDE. See Abstr. 2209

539.2 : 539.14

2926. CALCULATION OF FREQUENCIES AND RELATIVE INTENSITIES OF NUCLEAR SPIN RESONANCE LINES IN CRYSTALS.

M.Bloom, L.B.Robinson and G.M.Volkoff.

Canad. J. Phys., Vol. 36, No. 10, 1286-94 (Oct., 1958).

Previous calculations of the dependence on the strength of the external magnetic field H_0 of the energy levels and the expected frequencies of nuclear spin resonance lines of Al^{27} nuclei in a single crystal of $LiAl(SiO_3)_2$ (spodumene) were extended over a wide range of H_0 to more general orientations of the crystal with respect to H_0. In order to describe the variation with H_0 of the relative signal strength of a nuclear spin resonance line in a crystal, as observed with a crossed-coil spectrometer, a system of modified Bloch equations was set up which describe the behaviour of the magnetization vector of a two-level system when transitions are induced by an oscillating magnetic field. Solutions of these equations are used to explain the difference in the dependence on H_0 of signal strengths in crossed-coil and in single-coil spectrometers.

539.2 : 539.14

2927. THE NUCLEAR SPIN RESONANCE SPECTRUM OF Al^{27} IN SPODUMENE.

L.B.Robinson.

Canad. J. Phys., Vol. 36, No. 10, 1295-307 (Oct., 1958).

An experimental study was made of the nuclear spin resonance spectrum of Al^{27} in a single crystal of spodumene $[LiAl(SiO_3)_2]$ over a range of external magnetic field H_0 wide enough $(0 \leq R \equiv 4\ H_0/eQ\phi_{zz} < 2)$ to bridge for the first time the gap between pure quadrupole spectra $(R = 0)$ and Zeeman spectra slightly perturbed by quadrupole interactions $(R \gg 1)$. Experimental results on the resonance frequencies and relative signal amplitudes obtained with an induction type of nuclear resonance spectrometer are described, and are found to be in good agreement with the theoretical predictions given in the companion paper (see preceding abstract).

539.2

2928. NUCLEAR MAGNETIC RESONANCE IN β-BRASS.

G.W.West.

Nature (London), Vol. 182, 1436 (Nov. 22, 1958).

A copper nuclear magnetic resonance is reported in β-brass containing 48.33% zinc by weight. The line shows a smaller Knight shift, smaller integrated area and smaller width than in pure copper, and it can be eliminated almost completely by plastic deformation.

J.M.Baker

539.2

2929. THEORY OF LINE NARROWING BY DOUBLE-FREQUENCY IRRADIATION.

F.Bloch.

Phys. Rev., Vol. 111, No. 3, 841-53 (Aug. 1, 1958).

Starting from the general equation for the distribution matrix, magnetic resonance absorption in crystals is treated by introducing the Fourier transform of the resonance line which is shown to have the convenient form of a simple trace. The method is first applied to rederive some earlier results of Van Vleck, concerning the moments of the line. It is then extended to include the case of the following experimental paper (see following abstract), where resonance absorption of one magnetic ingredient is observed while another magnetic ingredient is at the same time subjected to a strong resonant r.f. field. It is shown that the absorption line exhibits a centre line and faint sidebands, and formulae for the intensity and shape of these lines are developed. In particular, it is shown that the total second moment of the absorption is unaltered by irradiation of the other ingredient. A quantitative measure for the observed narrowing of the centre line is found through the reduction of its second moment, which is compensated by the contribution of the sidebands to the total second moment.

539.2

2930. DOUBLE NUCLEAR MAGNETIC RESONANCE AND THE DIPOLE INTERACTION IN SOLIDS.

L.R.Sarles and R.M.Cotts.

Phys. Rev., Vol. 111, No. 3, 853-9 (Aug. 1, 1958).

The nuclear magnetic dipole interactions in a polycrystalline sample of sodium fluoride were investigated using an extension of the magnetic resonance technique. The resonance absorption of Na^{23} was observed with a variable-frequency spectrometer in a fixed external magnetic field, and the mean square width of the line shape computed. This width has two main sources: (a) the interaction of Na^{23} nuclei with other Na^{23} nuclei through the dipole fields of the magnetic moments, and (b) the interaction of Na^{23} nuclei with neighbouring F^{19} nuclei by the same mechanism. The application of a strong r.f. field satisfying the resonance condition for F^{19} nuclei in the same external field caused rapid transitions between the fluorine Zeeman energy levels, and thus altered the average field produced at the position of sodium nuclei by the nuclear magnetic moments of fluorine. By varying the strength of this r.f. field and also by varying the deviation from precise resonance of the F^{19} spins, one could selectively alter the contributions of this source of line broadening. The available r.f. field was not sufficiently intense to eliminate entirely the broadening caused by source (b). However, the detailed behaviour of this contribution to the width as a function of the deviation from resonance agrees well with a theory of Bloch (see preceding abstract) for the case of the r.f. field strong compared to the line widths involved.

539.2

2931. THE NARROWING OF NUCLEAR MAGNETIC RESONANCE SPECTRA BY MOLECULAR ROTATION IN SOLIDS.

E.R.Andrew and R.A.Newing.

Proc. Phys. Soc., Vol. 72, Pt 6, 959-72 (Dec., 1958).

Molecular rotation in a solid causes a narrowing of the spectrum and a consequent reduction of its second moment. It is shown that the rotation also produces weak side-spectra which are usually unobservable. If these side-spectra are included the second moment of the entire spectrum is the same as that for the rigid solid, thus preserving the invariance of the second moment. The cases of rotating and randomly reorienting pairs of nuclei are discussed in detail. The fourth moment of the entire spectrum is found to be increased by the motion, though that of the observable central portion is diminished.

539.2

2932. ON POLARIZATION OF THE NUCLEAR MOMENTS AND THE NUCLEAR RESONANCE LINE-WIDTHS IN CRYSTALS OF THE Cu^{++} ION SALTS.

Sh.Sh.Bashkirov and K.A.Valiev.

Zh. eksper. teor. Fiz., Vol. 35, No. 3(9), 678-84 (1958). In Russian.

The probabilities of nuclear relaxation transitions in Cu^{++} ion salts are computed. The magnitude of nuclear polarization appearing on saturation of electron and nuclear resonance transitions is calculated. The effect of electron and nuclear relaxation on broadening of the nuclear resonance lines in paramagnetic atoms is considered.

539.2

2933. ELECTRON SPIN—LATTICE RELAXATION IN PHOSPHORUS-DOPED SILICON.

H.Honig and E.Stupp.

Phys. Rev. Letters, Vol. 1, No. 8, 275-6 (Oct. 15, 1958).

The relaxation probability for a sample containing 1.4×10^{16} phosphorus atoms per cm^3 was measured as a function of the magnetic field at 1.27°K and 2.06°K. Room temperature radiation was excluded so as to eliminate any contribution from photoelectrically excited conduction electrons, and the results are thus characteristic of phonon-produced interactions. The probabilities are several orders of magnitude larger than theoretical predictions.

E.F.W.Seymour

539.2

2934. ON SOME PECULIARITIES OF CYCLOTRON RESONANCE IN METALS WITH NON-CONVEX FERMI SURFACES.

É.A.Kaner.

Zh. eksper. teor. Fiz., Vol. 35, No. 4(10), 962-4 (1958). In Russian.

It is shown that "logarithmic" cyclotron resonance should take place at Larmor frequencies near the hyperbolic limiting points of a non-convex Fermi surface.

539.2

2935. PARAMAGNETIC RESONANCE SPECTRUM OF COBALT IN CERIUM MAGNESIUM NITRATE AT 4°K.

W.B.Gager, P.S.Jastram and J.G.Daunt.

Phys. Rev., Vol. 111, No. 3, 803-9 (Aug. 1, 1958).

Paramagnetic resonance spectra of cobalt in crystals containing cerium and bismuth magnesium nitrate were studied at 4°K for various cerium-bismuth ratios. It is found that the cobalt hyperfine spectrum, well resolved in pure bismuth magnesium nitrate, is strongly attenuated by the addition of small percentages of cerium. For ionic cerium concentrations higher than 20% of the cerium-bismuth total, the cobalt hyperfine components cannot be resolved at all, except for the particular case of a 50% mixture. The attenuation of the cobalt spectrum is attributed to magnetic dipole interactions with the cerium ion, and it is suggested that this may also account for the fact that the observed degree of Gorter–Rose orientation of Co^{60} in cerium magnesium nitrate disagrees with the results of calculations that do not include the effect of dipole–dipole interactions.

539.2

2936. PARAMAGNETIC RESONANCE OF FREE RADICALS IN WEAK FIELDS. A.K.Chirkov and A.A.Kokin.
Zh. eksper. teor. Fiz., Vol. 35, No. 1(7), 50-5 (1958). In Russian.

The shape and width of the electron paramagnetic resonance absorption line of crystalline α-diphenyl β-picryl hydrazil (DPPH) was studied in weak fields at room temperature. It is shown that near the maximum the shape of the curve can be described by a Lorentz curve. The estimate of the half-width is in good agreement with the theory. The asymptotic Curie points were calculated for a number of new radicals.

539.2 : 536.424.1

2937. PARAMAGNETIC RELAXATION IN CHROMIUM-POTASSIUM AND IRON-AMMONIUM SULPHATES. N.S.Garif'yanov.
Zh. eksper. teor. Fiz., Vol. 35, No. 3(9), 612-17 (1958). In Russian.

A phase transition was detected in single crystals of chromium-potassium and ammonium-iron sulphates $[CrK(SO_4)_2.12H_2O$ and $FeNH_4(SO_4)_2.12H_2O]$ by the paramagnetic relaxation method in the interval from 90 to 300°K.

539.2 : 537.311.62

2938. CONTRIBUTION TO THE THEORY OF PARAMAGNETIC RESONANCE IN METALS.
M.Ya.Azbel', V.I.Gerasimenko and I.M.Lifshits.
Zh. eksper. teor. Fiz., Vol. 35, No. 3(9), 691-702 (1958). In Russian.

Using the results of the general theory developed earlier (Abstr. 2656/1958), dependence of the surface impedance in metals under conditions of paramagnetic resonance on the dispersion law of conduction electrons and on the angle of inclination of the constant magnetic field to the surface of the metal was investigated. The case of resonance saturation is examined.

539.2

2939. ON THE OVERHAUSER EFFECT IN NON-METALS. II.
G.R.Khutsishvili.
Zh. eksper. teor. Fiz., Vol. 35, No. 4(10), 1031-8 (1958). In Russian.

For Pt I see Abstr. 8435 (1958). An expression was obtained for the degree of stationary polarization of nuclei under the condition of partial saturation of one of the components of the paramagnetic resonance hyperfine structure in a paramagnetic salt or in a semiconductor with a donor or acceptor impurity. The degree of polarization for the same partial saturation of all the paramagnetic resonance components was computed. In the case $I = \frac{1}{2}$ the role of non-contact terms in nuclear relaxation was also taken into account. Methods of measurement of polarization are considered.

539.2

2940. ON THE THEORY OF PARAMAGNETIC RESONANCE AND PARAMAGNETIC RELAXATION IN METALS.
V.V.Andreev and V.I.Gerasimenko.
Zh. eksper. teor. Fiz., Vol. 35, No. 5(11), 1209-15 (1958). In Russian.

A kinetic equation for conduction electrons in metals was obtained which is valid for investigation of paramagnetic resonance. The case of uniform distribution of an alternating field in a metal is considered in detail. It is shown that for temperatures $kT \gg \mu H_0$, "longitudinal" and "transverse" spin relaxation times can be introduced, these times being practically equal.

539.21

2941. COMPARISON OF ELECTRON WITH NEUTRON IRRADIATION OF α-BRASS. A.C.Damask.
J. Phys. Chem. Solids, Vol. 4, No. 3, 177-81 (1958).

The decrease in electrical resistivity of α-brass which arises from increased short-range order is used as a measure of migration of excess vacancies during neutron and electron irradiation. It is shown that irradiation by 2 MeV electrons from a Van de Graaff generator will decrease the resistivity at the same rate as irradiation in the B.N.L. reactor. However, theoretical estimates indicate that about fourteen times more vacancies are produced by the electron than by the neutron irradiation. The results demonstrate, however, that electron irradiation, although less efficient is a feasible method for enhancing order in an alloy at temperature well below those at which ordering can be achieved by thermal annealing alone.

539.21 : 536.48

2942. SUPERFLUID HELIUM INSIDE NEUTRON-IRRADIATED SILICON. P.H.Keesom and G.Seidel.
Phys. Rev., Vol. 111, No. 2, 422-4 (July 15, 1958).

The specific heat of a boron-doped silicon crystal, which was first irradiated with thermal neutrons and then annealed, showed a pronounced peak at the normal λ temperature of liquid helium. The anomaly is due to the existence of helium inside the ingot, this helium being created by the boron—neutron reaction $B^{10} + n^1 \rightarrow He^4 + Li^7$. On annealing, sufficient helium collected in macroscopic defects within the crystal to liquefy and produce the observed specific heat.

539.21 : 537.311.33

2943. RADIATION DAMAGE IN Ge AND Si DETECTED BY CARRIER LIFETIME CHANGES: DAMAGE THRESHOLDS.
J.J.Loferski and P.Rappaport.
Phys. Rev., Vol. 111, No. 2, 432-9 (July 15, 1958).

Minority carrier lifetime, τ, in semiconductors is shown to be more sensitive, by a factor of 10^4, to radiation-induced defects than the conductivity. Thus, in some cases, the introduction of as few as 10^{10} defects per cm^3 can be detected by its effect on τ. Both direct measurements of τ, and measurements of dependent parameters (such as the photovoltaic effect and the particle voltaic effect) are described for Si and Ge. Using such parameters, and an electron acceleration, the minimum energy needed to produce a Frenkel defect was found to be 14.5 ± 0.4 eV in Ge and 12.9 ± 0.6 eV in Si. An analysis of the phenomenon shows how the location of the radiation-induced energy levels and the relative minority carrier capture cross-sections can be determined experimentally. The shape of the curve of the displacement cross-section v. the incident particle energy is compared with calculations from collision theory. Qualitative explanations for the observed "tail" on this curve are presented. Calculations based on these explanations fail to yield complete agreement with the experimental curves.

STRUCTURE OF SOLIDS

539.211 : 537.534.9

2944. APPLICATION OF THE ION-BOMBARDMENT CLEANING METHOD TO TITANIUM, GERMANIUM, SILICON, AND NICKEL AS DETERMINED BY LOW-ENERGY ELECTRON DIFFRACTION.
H.E.Farnsworth, R.E.Schlier, T.H.George and R.M.Burger.
J. appl. Phys., Vol. 29, No. 8, 1150-61 (Aug., 1958).

The ion-bombardment cleaning method was successfully applied to the (100) faces of germanium, silicon, and nickel, and to the (0001) face of titanium. Conditions and precautions necessary for the production of clean surfaces are described. Tests were made for contamination from the ambient during the cleaning procedure for germanium. It was shown that contamination approximating one-half monolayer does not occur under the conditions which were obtained, and that the method is capable of producing surfaces which are atomically clean. Results for clean (100), (111) and (110) germanium faces and the (100) silicon face indicate that the atomic positions in the surface planes are not the same as the corresponding positions in the bulk structure. For (100) nickel and (0001) titanium, the positions of the atoms in the surface planes are in agreement with X-ray data. In the case of titanium, an unidentified surface structure was present until after several cycles of alternate heating and ion bombardment. In the case of nickel, a double-spaced surface monolayer and in some cases a single-spaced, simple-square structure, attributed to carbon, was present until after several cycles of alternate heating and ion bombardment.

539.211

2945. ON ASPERITY DISTRIBUTIONS OF METALLIC SURFACES. F.F.Ling.
J. appl. Phys., Vol. 29, No. 8, 1168-74 (Aug., 1958).

A distribution of surface asperities is proposed for the case in which both mating surfaces are rough and asperities are in the form of right circular cones. The assumption of this particular asperity form is suggested by roughness measurements of ground steel, brass, and aluminium which yielded similar results for stylus traversing parallel, 45°, and perpendicular to lay. Considering the mating cones perfectly plastic and distributed in the proposed manner, bulk deformation-load is related to compliance. The essential finding is that the load-compliance characteristics for mating surfaces having comparable roughness have slopes much steeper than those predictable by previous theories, all of which involve the assumption that one of the surfaces is smooth and rigid. A simple experiment is described in which load and compliance are measured. Results seem to support the plausibility of the proposed theory. Moreover, this plausibility shows promise of the calculation of other bulk-quantities such as frictional resistance.

539.217 : 533.15

2946. THE DIFFUSION OF CARBON AND OXYGEN IN VANADIUM. R.W.Powers and M.V.Doyle.
Acta metallurgica, Vol. 6, No. 10, 643-6 (Oct., 1958).

Carbon diffuses in vanadium at a slightly more rapid rate than oxygen. From internal friction and elastic after-effect measurements, the diffusion coefficients of these interstitial impurities as functions of temperature were found to be

$$D_{C-V} = 0.0047 \exp(-27\,300/RT) \text{ cm}^2/\text{sec}$$

and

$$D_{O-V} = 0.019 \exp(-29\,300/RT) \text{ cm}^2/\text{sec}.$$

In contrast to solutions of oxygen in vanadium, those of carbon are unstable, as evidenced by a decline in the height of the carbon—vanadium damping peak with time. This decline is attributed to the precipitation of vanadium carbide from a supersaturated solution. A similar instability was found previously in solutions of carbon in niobium and tantalum.

539.217

2947. DIFFUSION IN MULTICOMPONENT METALLIC SYSTEMS. IV. A GENERAL THEOREM FOR CONSTRUCTION OF MULTICOMPONENT SOLUTIONS FROM SOLUTIONS OF THE BINARY DIFFUSION EQUATION. J.S.Kirkaldy.
Canad. J. Phys., Vol. 37, No. 1, 30-4 (Jan., 1959).

For Pts I-III, see Abstr. 835-7 (1959). If $C = C(x,y,z,Dt)$ is a solution of the binary diffusion equation

$$\frac{\partial C}{\partial t} = D\nabla^2 C$$

for a given boundary condition, then

$$C_i = a_{io} + \sum_{k=1}^{n-1} a_{ik} C(x,y,z,u_k t),$$

where

$$u_k = \sum_{j=1}^{n-1} D_{ij} a_{jk}/a_{ik}$$

is a solution of

$$\frac{\partial C_i}{\partial t} = \sum_{k=1}^{n-1} D_{ik} \nabla^2 C_k$$

for the i-th component of an n-component system subject to the same formal boundary condition. As an example, the ternary diffusion field about an initial point source is calculated. The method of calculation for steady state and transient equilibrium is indicated.

539.217

2948. DIFFUSION OF GALLIUM IN SILICON. A.D.Kurtz and C.L.Gravel.
J. appl. Phys., Vol. 29, No. 10, 1456-9 (Oct., 1958).

The diffusion of gallium into silicon was investigated over a temperature range of 1130-1358°C using an open-tube vapour—solid diffusion technique at atmospheric pressure. A p—n junction method combined with incremental conductivity measurements of the diffused layer was used to determine the diffusion constant. Lower diffusivities, and a somewhat higher activation energy ($\Delta H = 95$ kcal), were obtained than those previously reported. The difference is attributed to variation of diffusivity with surface concentration and is discussed on the basis of substitutional diffusion proceeding by a vacancy mechanism.

539.217 : 533.15

2949. DIFFUSION OF HYDROGEN IN PALLADIUM. P.A.Silberg and C.H.Bachman.
J. chem. Phys., Vol. 29, No. 4, 777-81 (Oct., 1958).

The rate of flow of hydrogen through palladium was measured in a range from 200° to 600°C, over the pressure range from 10 to 70 cm Hg. The flow rate is found insensitive to palladium wall thickness. The data do not seem to be explainable in terms of existing theory.

539.217

2950. MEASUREMENT OF THE DIFFUSION IN OXIDE CRYSTALS BY ISOTOPIC EXCHANGE WITH GASEOUS OXYGEN. R.Haul and D.Just.
Naturwissenschaften, Vol. 45, No. 18, 435-6 (1958). In German.

Single crystals of cadmium oxide, 50 μ in size, were heated in an atmosphere of oxygen enriched with O^{18}. The anion diffusion coefficients were determined, at 600, 649 and 698°C by measuring the change of isotopic concentration of the gas with a mass spectrometer. The observed temperature increment corresponded with that expected for vacancy diffusion. B.T.M.Willis

539.217

2951. A NOTE ON THE THEORY OF DIFFUSION OF COPPER IN GERMANIUM. M.D.Sturge.
Proc. Phys. Soc., Vol. 73, Pt 2, 297-306 (Feb., 1959).

The theory of Frank and Turnbull of the diffusion of copper in germanium is extended to take into account the finite rate of generation of vacancies in the bulk, and the finite reaction rate in the postulated dissociation of a substitutional copper atom into an interstitial and a vacancy. Comparison of the extended theory with experiment yields an order of magnitude estimate of 10^{-8} cm for the effective radius of a dislocation for annihilation of a vacancy. It is shown that this result is consistent with the view that vacancy generation and annihilation occurs at dislocation jogs, provided that attraction of an edge dislocation for a vacancy is taken into account.

539.219

2952. VACANCY DIFFUSION IN ORDERED ALLOYS. E.W.Elcock.
Proc. Phys. Soc., Vol. 73, Pt 2, 250-64 (Feb., 1959).

A mechanism of vacancy diffusion in ordered alloys is examined in some detail for the stoichiometric simple cubic binary alloy. Upper and lower bounds for the ratio G of the self-diffusion coefficients of the two components of the alloy are calculated as functions of the temperature in the reduced temperature range $0 \leq T/T_c \leq 0.5$, where T_c is the critical temperature of ordering. In this temperature range it is found that $1/a \leq G \leq a$ where $a \cong 2$ and only slightly temperature dependent. Such experimental evidence as there is bears out this simple yet striking result.

539.219

2953. ON THE ATOMIC ORDERING OF THE SOLID SOLUTION GOLD-NICKEL. A.Münster and K.Sagel.
Naturwissenschaften, Vol. 45, No. 19, 462-3 (1958). In German.

The diffuse X-ray scattering was studied down to a scattering angle of $\frac{1}{2}^{\circ}$. The results indicate that like atoms tend to cluster together, as expected on thermodynamic grounds.
B.T.M.Willis

539.219

2954. SOLID SOLUTION IN ZINC BLENDE TYPE $A_2^{III}B_3^{VI}$ COMPOUNDS. J.C.Woolley and B.A.Smith.
Proc. Phys. Soc., Vol. 72, Pt 5, 867-73 (Nov., 1958).

Ranges of solid solution were investigated in systems composed of either two $A_2^{III}B_3^{VI}$ compounds or one $A^{III}B^{V}$ and one $A_2^{III}B_3^{VI}$ compound. It is found that in practically all cases considered complete solid solution throughout the whole range of composition can be obtained, but that in some cases this equilibrium condition can only be reached under special conditions of temperature and time of annealing. The possibility of ordering and of the occurrence of low temperature miscibility gaps is investigated.

539.219

2955. DIAMAGNETIC NUCLEAR MAGNETIC RESONANCE SHIFTS IN ALLOYS. R.G.Shulman, B.J Wyluda and B.T.Matthias.
Phys. Rev. Letters, Vol. 1, No. 8, 278-9 (Oct. 15, 1958).

Reports large diamagnetic shifts (up to 0.62%) for tin and gallium resonances in Nb_3Sn, V_3Sn and V_3Ga. All resonant nuclei are in a body centre cubic site in a β tungsten lattice. The shifts vary by a factor of three in the temperature range 20 to 300°K. Line-widths about 9 gauss due to dipolar broadening. No shift was observed in the isomorphous alloy Nb_3Ga. Other tin compounds (SnO_2, SnS etc.) show a paramagnetic Sn^{119} shift. No evidence of connection with tendency of β tungsten structure to superconductivity. No explanation is given. J.G.Powles

539.219

2956. ON THE KINETICS OF DIFFUSIONAL DECAY OF SUPERSATURATED SOLID SOLUTIONS. I.M.Lifshits and V.V.Slezov.
Zh. eksper. teor. Fiz., Vol. 35, No. 2(8), 479-92 (1958). In Russian.

The kinetics of the diffusional process of formation of grains of a new phase in a supersaturated solid solution is studied at a late stage of the process (coalescence of the grains). The exact asymptotic solution of this problem was obtained and investigated. The asymptotic distribution function was derived, the asymptotic number and average dimensions of the grains were determined and the process of establishment of the asymptotic laws analysed. As an example of application of the theory the mechanism of sintering is considered.

539.219

2957. SOLID SOLUTIONS IN THE SYSTEM Ga_2Te_3—In_2Te_3.

V.S.Grigor'eva.

Zh. tekh. Fiz., Vol. 28, No. 8, 1670-1 (1958). In Russian.

Seven different compositions in the Ga_2Te_3—In_2Te_3 system were prepared by slow cooling in sealed silica tubes. X-ray measurements showed that homogeneous solid solutions with zinc blende structure were formed, lattice constant varying linearly with composition. Electrical conductivity and photoconductivity showed these solid solutions to be semiconductors. C.H.L.Goodman

539.219

2958. SOLID SOLUTIONS IN THE SYSTEM InAs—In_2Se_3.

N.A.Goryunova and S.I.Radautsan.

Zh. tekh. Fiz., Vol. 28, No. 9, 1917-21 (1958). In Russian.

Polycrystalline specimens (mostly n-type) were prepared by slow cooling of the melted constituents from ~1000°C in sealed silica tubes. X-ray analyses showed solid solutions with zinc-blende structure from InAs up to 0.4 InAs—0.6 In_2Se_3, the lattice constant varying linearly with composition. Beyond this composition an unknown phase of low crystal symmetry was found. Measurements of microhardness were also made. Photomicrographs of various specimens are shown. C.H.L.Goodman

539.219

2959. SOLID SOLUTIONS IN THE SYSTEM InAs—In_2Te_3.

N.A.Goryunova and S.I.Radautsan.

Dokl. Akad. Nauk SSSR, Vol. 121, No. 5, 848-9 (1958). In Russian.

Specimens were prepared as in preceding abstract. X-ray, thermal and microscopic analyses showed a continuous range of solid solutions with zinc-blende structure, the lattice constant varying linearly with composition. Liquidus and solidus temperatures are given for 5 intermediate compositions. Microhardness was at a maximum ~0.75 InAs—0.25 In_2Te_3. Electrical conductivity fell off sharply as the In_2Te_3 content was increased reaching 10^{-6} ohm^{-1} cm^{-1} for In_2Te_3 itself. C.H.L.Goodman

539.219 : 536.212.2

THERMAL CONDUCTIVITY OF DISORDERED DIELECTRIC ALLOYS. See Abstr. 2262

539.234

2960. THE TEXTURE OF ZINC AND CADMIUM FILMS DEPOSITED ON FRESH CLEAVAGE FACES OF MICA.

V.R.G.Moorti and M.K.Gharpurey.

Canad. J. Phys., Vol. 36, No. 10, 1319-22 (Oct., 1958).

Zinc and cadmium films condensed from vapour in vacuo on the two sides of mica cleavage exhibit well-matched textures in the corresponding regions on the two sides. In those cases where the deposition is due to the Frenkel mechanism of homogeneous nucleation, there is similarity in the gross features alone. On the other hand, when the condensation is due to the presence of "active" centres of nucleation on the mica surface, there is generally a "one-to-one" correspondence between the crystallites on the two faces.

539.234

2961. STABILITY OF EVAPORATED FILMS.

M.W.Roberts.

Nature (London), Vol. 182, 1151-2 (Oct. 25, 1958).

From krypton adsorption measurements, the changes in surface area produced by low-temperature thermal cycling were studied in evaporated iron films. The surface area was reduced by a factor of 0.43 for a 'clean' film and 0.23 for an oxidized film. A further decrease in area of the clean film occurred on ageing.

B.T.M.Willis

539.27

2962. A SIMPLE APPARATUS FOR FIXING ELECTRON MICROSCOPE SPECIMENS IN OSMIC VAPOUR.

R.Vendramini.

Atti Soc. Peloritana Sci. Fis. Mat. Nat., Vol. 2, No. 3, 193-5 (1956). In Italian.

A simple arrangement is described which eliminates some of the inconvenience experienced in fixing specimens in osmium tetroxide vapour. The grid carrying the specimen is placed on a silver or brass gauze in a small glass vessel connected by a tube and tap to a lower vessel in which the osmium tetroxide is contained. The tap is opened and the vapour admitted to the upper vessel for the required time. The operator is exposed only to the very small amount of vapour released from the upper vessel when the specimen is removed. V.E.Cosslett

539.27

2963. RECENT PROGRESS IN THE TECHNIQUES OF ELECTRON DIFFRACTION.

J.J.Trillat.

Cahiers de Phys., Vol. 11, 269-76 (July, 1957). In French.

A continuous record of the electron diffraction pattern is obtained by using a moving film and selecting part of the ring pattern by means of a narrow slit placed at right angles to the direction of motion of the photographic plate. Oxidation studies can be made by heating the specimen in position. Furthermore, by means of an auxiliary ion gun the specimen may be thinned in situ by ion bombardment and a continuous record obtained of the resulting diffraction patterns. A.E.I. Research Laboratory

539.27

2964. EVALUATION OF ELECTRON DIFFRACTION PHOTOGRAPHS BY THE METHOD OF FOURIER ANALYSIS.

H.Richter and S.Steeb.

Naturwissenschaften, Vol. 45, No. 19, 461 (1958). In German.

In electron diffraction photographs of thin metal films, an unwanted background of multiple and incoherent scattering is imposed on the coherent part of the pattern. This makes the Fourier analysis of amorphous and liquid substances impracticable. By determining the background from the corresponding polycrystalline material this difficulty can be overcome. An example is given of the structural analysis of amorphous germanium.

A.E.I. Research Laboratory

539.27

2965. ELECTRON INTERFEROMETRIC MEASUREMENT OF THE INNER POTENTIAL OF CARBON FILMS.

W.Langbein.

Naturwissenschaften, Vol. 45, No. 21, 510-11 (1958). In German.

Möllenstedt and Keller (Abstr. 7958/1957) obtain a value of 24 V for the inner potential of carbon films using an interference method and obtaining the density by the optical density method described by Agar (Abstr. 6924/1957). Later A. and V.Cosslett (Abstr. 9092/1957) suggested a value of 15 V. The present author has re-determined the inner potential by direct measurement of all quantities involved. A value of 14.2 ± 1.0 V was obtained.

A.E.I. Research Laboratory

539.27

2966. MULTIPLE INTERFERENCE FRINGES IN ELECTRON MICROGRAPHS OF WEDGE-SHAPED SINGLE CRYSTALS.

R.E.Burge.

Proc. Phys. Soc., Vol. 73, Pt 1, 45-8 (Jan., 1959).

Multiple interference fringes were observed in electron micrographs of wedge-shaped single crystals of poly-L-proline II. The interference fringes which occur when strong Bragg reflection is possible were observed to split into two components as a result of secondary electron scattering and double refraction within the crystals. The separation of the fringe components is a function of the deviation of the incident electron beam from the exact Bragg condition for the reflection. The fringe contours are qualitatively interpreted using the dynamical theory of electron scattering.

539.27 : 537.533.35

GRAPHICAL METHOD FOR ESTIMATION OF CONTRAST IN ELECTRON MICROSCOPY. See Abstr. 2406

ELASTICITY . STRENGTH . RHEOLOGY

539.31

2967. STRESS—STRAIN EQUATION FOR RUBBER IN TENSION.

W.E.Claxton.

J. appl. Phys., Vol. 29, No. 10, 1398-406 (Oct., 1958).

A stress—strain equation is derived for a homogeneous, isotropic material with the assumptions that for any given homogeneous simple tensile strain, the components of the stress tensor are to the first approximation linear, homogeneous functions of the components of the strain tensor and that no volume change occurs during the deformation. Utilizing the dependence of Poisson's ratio upon the extension referred to the initial coordinates, one elastic coefficient, C_{12}, is found to be sufficient to roughly characterize the first stretch stress—strain curve. Although experimentally this elastic coefficient is found to be essentially constant for extensions greater than 25% its value increases rapidly as zero extension is approached.

This behaviour agrees qualitatively with data by Blanchard and Parkinson as to the distribution of secondary bond strengths, wherein they found a large number of relatively low-energy bonds which would be effective only at small extensions in contributing to modulus reinforcement. Various aspects of stress—strain and cure behaviour are examined with the derived equation as a basis.

539.32

2968. NUMBER OF ELASTIC CONSTANTS REQUIRED IN CRYSTAL ELASTICITY. N.Joel and W.A.Wooster.

Nature (London), Vol. 182, 1078-9 (Oct. 18, 1958).

It is assumed that, in a crystal subject to mechanical strains only, the appearance of body couples in a certain element of volume depends on the presence of deformation. Substitutions are made in the strain energy function for pure shear deformation and pure rotation around an axis parallel to X_a in every element of volume. The energy density can then be separated into three parts, one having terms containing pure deformations only, one with terms containing pure rotations only and one with terms containing both deformations and rotations. The analysis shows that the coefficients of six of the terms in the purely rotational work density function vanish and this reduces by 6 the number of independent elastic constants required for a triclinic crystal, i.e. from 45 to 39. A.C.Whiffin

539.32

2969. ELASTIC CONSTANTS OF DIAMOND.

W.A.Wooster and N.Joel.

Nature (London), Vol. 182, 1149 (Oct. 25, 1958).

The interpretation of the measurements of the elastic constants of diamond made by Prince and Wooster is considered in the light of the new theory of elasticity. Uncertainties in the measurements of the intensity of the Compton scattering and in the compressibility make it impossible to establish a significant difference between d_{44} and d_{45}. Thus experimental proof that the three classical elastic constants do not suffice for the diamond cannot yet be given. The authors assert that the number of independent elastic constants is 39 and not 45 as proposed in Laval's theory. H.J.H.Starks

539.32

2970. INVESTIGATION OF LOW-TEMPERATURE INTERNAL FRICTION. H.L.Caswell.

J. appl. Phys., Vol. 29, No. 8, 1210-14 (Aug., 1958).

The internal friction in pure copper, in copper doped with nickel and gold, and in magnesium, subjected to various amounts of cold work was measured at 40 kc/s from 4°K to 300°K. Cold work produces a Bordoni relaxation peak in copper at approximately 80°K. The peak position is independent of the amplitude of vibration for strain amplitudes less than 3×10^{-5}. Suitable annealing reduces and eliminates the peak, as does the presence of relatively large quantities of impurities. Increased cold work and impurity additions also systematically reduce the strain amplitude of the internal friction. A peak was found in cold-worked magnesium at 20°K and also a small peak in crystalline quartz at 39°K. A comparison of present theories with these results is given.

539.32

2971. APPARATUS FOR THE MEASUREMENT OF SHEAR MODULUS AND INTERNAL FRICTION BETWEEN 4.2 AND 100°K.

K.M.Sinnott.

J. appl. Phys., Vol. 29, No. 10, 1433-7 (Oct., 1958).

An apparatus has been constructed to measure the shear modulus and logarithmic decrement of polymers from 4.2 to 100°K. The apparatus consists of a small torsion pendulum suspended on a rigid support at the bottom of a large glass Dewar vessel. After cooling to 4.2°K with liquid helium, the pendulum warms up at an initial rate of 0.1 deg per minute. Torsional oscillations of the pendulum are excited electrically and recorded photographically. The estimated accuracy of the modulus and logarithmic decrement is ±5.0%. Measurements of the shear modulus and logarithmic decrement have been made, from 4.2 to 100°K, on a series of tetrafluoroethylene-hexafluoropropylene and copolymers.

539.32

2972. INTERNAL FRICTION OF COPPER AND COPPER ALLOYS.

D.N.Beshers.

J. appl. Phys., Vol. 30, No. 2, 252-8 (Feb., 1959).

A systematic experimental study was made of the effect of adding small amounts of gold to copper on the dislocation damping in copper measured at 37 kc/s in longitudinal resonance. The results have been classified in terms of the dependence of the damping on strain amplitude and time with temperature and composition as parameters. The data on amplitude dependence confirm the theoretical results of Granato and Lücke over the range 10^{-4} to 10^{-3} atom per cent gold, where the decrement, Δ, is given as a function of the strain amplitude of oscillation, ϵ, by

$$\Delta = \Delta_0 + (B'/\epsilon^{\frac{1}{2}}) \exp(-A'/\epsilon).$$

The dependence of A' and B' on concentration and other parameters is discussed. Above 150°C, at strains large enough for the damping to vary with strain amplitude, the damping may depend on time, t, at constant amplitude in a reversible manner. This dependence may be represented by

$$\alpha \exp(-\beta t^{\frac{2}{3}}) + ct + d)$$

with the exponential dominating in the pure specimens and the linear term at 10^{-3} atom per cent gold. A detailed consideration of this behaviour points strongly towards a vacancy-dislocation interaction as the source. About 280°C, and independently of gold concentration the damping starts to rise steeply with at least one thermally activated process involved. It appears that vacancies are involved here too. In supplementary measurements, the increase of resistivity of copper due to gold impurities was determined as 0.47_2 μohm cm per atom per cent gold.

539.32

2973. INTERNAL FRICTION OF LEAD. I. Y.Hiki.

J. Phys. Soc. Japan, Vol. 13, No. 10, 1138-44 (Oct., 1958).

Internal friction of single crystal of lead (99.99% pure) was measured with longitudinal vibration in kilocycle range, using a composite piezoelectric quartz oscillator. The dependences of the internal friction on the strain amplitude ($0.5 - 12 \times 10^{-6}$), on the frequency (64, 192 kc/s) of vibration, and on temperature (140-340°K) were mainly studied. The internal friction is of the order of 10^{-3} at low temperatures, and increases slightly as the temperature is raised, and increases also with increasing strain amplitude. Near the room temperature, the value of the internal friction rises steeply. A temperature (about 300°K) was found above which the internal friction decreases with increasing amplitude. The amplitude-dependent internal friction does not depend on the frequency of vibration, and the amplitude-independent one seems to be proportional to the frequency.

539.32

2974. THE INTERNAL FRICTION OF ANNEALED COPPER AT LOW TEMPERATURES. D.H.Niblett and J.Wilks.

Proc. Phys. Soc., Vol. 73, Pt 1, 95-9 (Jan., 1959).

The internal friction of annealed polycrystalline copper was measured as a function of strain amplitude in the temperature range 20° to 300°K. Both the amplitude-dependent and the amplitude-independent contributions to the decrement increase with increasing temperature over the whole range. Current theories are inadequate to account for the observed dependence of the friction on both strain amplitude and temperature.

539.32

2975. TEMPERATURE DEPENDENCE OF INTERNAL FRICTION IN PURE METALS AND ALLOYS. V.S.Postinkov.

Uspekhi fiz. Nauk, Vol. 66, No. 1, 43-77 (1958). In Russian.

Review with 253 references. R.F.S.Hearmon

539.32 : 537.226.2

ENERGY LOSS PROCESSES IN FERROELECTRIC CERAMICS. See Abstr. 2305

539.4

2976. EVALUATION OF TENSILE, COMPRESSIVE, TORSIONAL, TRANSVERSE, AND IMPACT TESTS AND CORRELATION OF RESULTS FOR BRITTLE CERMETS.

M.J.Kerper, L.E.Mong, M.B.Stiefel and S.F.Holley.

J. Res. Nat. Bur. Stand., Vol. 61, No. 3, 149-69 (Sept., 1958).

Static tests were studied for the determination of mechanical properties of brittle materials. Specimens of brittle materials, represented by cermets having five different compositions, were subjected to tensile, compressive, torsional, transverse, and impact tests. The designs of specimens and apparatus, suitability of the tests to the materials, refinements in test procedures, and the variability of results and their correlation were studied. The elastic properties were obtained from tensile, compressive, and transverse tests, and the modulus of rigidity calculated from the results of these tests agreed with that from the torsional test. Tensile strength was obtained from the tensile, torsional, and transverse tests on specimens of comparable sizes in accordance with a limiting tensile strain. Shear strengths were obtained in the compressive tests. The correlation of impact values with mechanical properties was unsatisfactory.

539.431 : 534.131

FATIGUE FAILURE OF STRUCTURES DUE TO VIBRATIONS. See Abstr. 2152

539.531

2977. HARDNESS OF NEUTRON-IRRADIATED DIAMONDS. A.C.Damask.
J. appl. Phys., Vol. 29, No. 11, 1590-3 (Nov., 1958).

The amount of wear of neutron-irradiated diamonds relative to unirradiated ones was compared after a standard grinding against silicon carbide. It is found that the amount of wear increases with increasing irradiation, i.e. the diamonds become softer with increasing irradiation. Measurements of density show that it decreases with increasing irradiation. The decrease of cohesive energy of an irradiated diamond is estimated from the number of broken bonds and the strain energy of the density change. The experiments indicate that dislocation motion is not responsible for the wearing of diamonds.

PHYSICAL CHEMISTRY

PHASE EQUILIBRIUM

CHEMICAL REACTIONS

541.127 : 532.72

2978. DIFFUSION AND CHEMICAL KINETICS. INTEGRATION OF THE PROBABILITY AFTER-EFFECT EQUATION FOR A SPHERICAL VOLUME ELEMENT. J.Rehner, Jr.
J. chem. Phys., Vol. 29, No. 4, 962-3 (Oct., 1958).

The integral expression given by Chandrasekhar (1943), for the probability that a particle initially outside a given volume element will be inside it after a certain time, is evaluated for the spherical case in terms of the error function. J.Hawgood

541.127

2979. STUDY OF THE PROTOLYSIS KINETICS OF AMMONIUM ION IN AQUEOUS SOLUTIONS BY PROTON MAGNETIC RESONANCE TECHNIQUE. S.Meiboom, A.Loewenstein and S.Alexander.
J. chem. Phys., Vol. 29, No. 4, 969-70 (Oct., 1958).

The protolysis kinetics were evaluated from measurements of the proton magnetic resonance line-widths of the NH_4^- triplet (due to N^{14} hyperfine structure) and water lines, as a function of pH value and ammonium ion concentration. J.M.Baker

ELECTROCHEMISTRY

541.13 : 621.319.45

2980. ON THE CURRENT DISTRIBUTION IN POROUS ELECTRODES. J.Euler.
Naturwissenschaften, Vol. 45, No. 22, 537-8 (1958). In German.

A simplified method for the determination of the distribution of ionic and electronic currents in porous electrodes is described. The porous electrode is considered as thin laminae and examined over a short period when electrolyte concentration changes do not become significant. The method can be applied to each concentration change. A numerical example for one simple case is described. The method can be applied to cylindrical electrodes and capacitors. 7 references. W.A.Walker

541.133

2981. TEMPERATURE DEPENDENCE OF THE CONDUCTIVITY OF ELECTROLYTE SOLUTIONS. N.van Meurs.
Nature (London), Vol. 182, 1532-3 (Nov. 29, 1958).

The maximum in the conductance as a function of temperature is claimed to be a general phenomenon valid for all electrolytes that are slightly ionized. The variation of conductance with temperature is given by a relationship of the form

$$\ln \kappa = -(A/T) - BT + C,$$

where A, B, and C are (positive) constants. W.Good

541.135

2982. ELECTRODES FOR pH MEASUREMENT. I-II. A.Kuntze.
Arch. tech. Messen., No. 269, (Ref. V332-19), 117-20 (June); No. 271, (Ref. V332-20), 161-4 (Aug., 1958). In German.

Improved designs both of reference and measuring electrodes are given with illustrations. The reference electrode of choice is calomel with saturated KCl and its temperature characteristics and susceptibility to external agents are discussed. A glass electrode is now the principal measuring electrode and its performance is compared with that of earlier types. It has a temperature coefficient which is generally unsymmetrically related to pH, but which can be accurately allowed for. The high resistance of the glass (50-1000 mΩ for Corning 015) necessitates electrometer techniques and screened leads are required. The system tends to error at both extremes of the range and the magnitudes of these errors are indicated graphically for different glasses. Detailed designs of immersion, flat-ended and other special electrodes are given, including types for small volume (0.02 ml) measurement. F.T.Farmer

541.135.2 : 532.77

A THEORETICAL EXPRESSION FOR SOLUBILITY PRODUCT. See Abstr. 2138

CHEMICAL ANALYSIS

545.8 : 536.2

2983. A DIFFERENTIAL THERMAL ANALYSIS APPARATUS. F.W.Wilburn.
J. sci. Instrum., Vol. 35, No. 11, 403-7 (Nov., 1958).

An automatic differential thermal analysis apparatus of high sensitivity is described in detail. The rate of heating is servo-controlled to give any selected value from 6 to 20° C per minute. Curves are obtained directly on an X—Y potentiometric recorder. Temperature differences can be detected to within 0.1 deg C. Reference is made to the application of the apparatus in the study of glass-making reactions.

545.824 : 537.531

ANALYSING UNRESOLVED PROPORTIONAL COUNTER CURVES OF X-RAY LINE SPECTRA. See Abstr. 2385

CRYSTALLOGRAPHY

548.1

2984. PROTON RESONANCE IN DIOPTASE $(CuSiO_3.H_2O)_6$. R.D.Spence and J.H.Muller.
J. chem. Phys., Vol. 29, No. 4, 961-2 (Oct., 1958).

The magnitude and orientation dependence of the paramagnetic shift of proton resonances in dioptase was used to determine the position of the protons in the crystal structure. The resonance was observed down to a possible order—disorder transition at 21°K.
J.M.Baker

548.24

2985. WORK OF FORMATION OF AN ELASTIC TWIN CRYSTAL IN CALCITE. I.V.Obreimov and V.I.Startsev.
Zh. eksper. teor. Fiz., Vol. 35, No. 5(11), 1065-73 (1958).
In Russian.

The linear dimensions and shape of an elastic twin in calcite produced under the action of a concentrated load were measured. The linear dimensions are proportional to the load, and the area of the twin surface is proportional to the work, performed by the press piston.

548.5

2986. CRYSTAL ORIENTATION IN ICE SHEETS.
F.G.J.Perey and E.R.Pounder.
Canad. J. Phys., Vol. 36, No. 4, 494-502 (April, 1958).

Crystal size and orientation in ice sheets frozen under one-dimensional cooling from melts of pure water or melts containing traces of organic additives were studied using a polariscope with a universal stage. The surface layer is found to consist of crystals with nearly vertical optic axes. Horizontal sections cut at various depths show a gradual change of the mean orientation of the optic axes towards the horizontal. The change to horizontal inclinations is almost completed at depths of 4 or 5 cm under the freezing conditions used, and occurs more rapidly with the melts containing additives. With additives the ice sheet shows another feature also, a transition layer about 0.5 cm below the surface. In this layer the crystals are much smaller than in the surface layer above them and the number of crystals extending through this layer is small. An explanation of the observations is offered, in terms of preferred growth of an ice crystal in planes perpendicular to the optic axis. This provides a mechanism permitting more rapid growth of crystals with inclined axes.

548.522

2987. GROWTH OF WHISKERS IN THE SOLID PHASE. J.Franks.
Acta metallurgica, Vol. 6, No. 2, 103-9 (Feb., 1958).

The growth of whiskers from clamped tin plate was studied. It is shown that general extrusion must be inhibited for whisker growth to occur. If whiskers are removed after they have reached their terminal length, whiskers may grow subsequently on the same sites. Whiskers grown at temperatures up to 190°C in vacuum are similar to those grown at room temperature. Near this temperature existing whiskers collapse on to the surface from which they grew and further growth does not occur. In the presence of oxygen, whiskers grow thicker and longer at 215°C than at room temperature. A dislocation model has been developed which explains the known features of whisker growth. Its chief features are that the whisker generating dislocations move by glide, while the material of the whisker is supplied by diffusion. Dislocations may be produced in the whisker by the mechanism but they are not an essential part of it.

548.522

2988. CRYSTAL GROWTH OF CdS BY VACUUM SEALED METHOD. H.Yamashita and S.Ibuki.
J. Phys. Soc. Japan, Vol. 13, No. 2, 226 (Feb., 1958).

A vapour—phase method of obtaining single crystals of CdS is described. Several plates are included which illustrate comments upon crystal growth directions and etch attack.
A.W.Penn

548.522

2989. GROWTH OF PREFERENTIALLY ORIENTED ALUMINUM SINGLE CRYSTALS. T.H.Orem.
J. Res. Nat. Bur. Stand., Vol. 60, No. 6, 547-9 (June, 1958).

Monocrystalline aluminium specimens having both a preferential orientation and a specified cross-sectional shape are very difficult to produce. Such specimens must be grown in a vertical furnace, a condition which, while permitting the choice of cross-sectional shape in the specimen, makes it extremely difficult to obtain specimens preferred orientation. It is fairly easy to grow preferentially orie ted monocrystalline aluminium specimens when a horizontal furna is used, but the use of such a furnace limits the choice of cross-sectional shapes in the finished crystal. Crystals of circular cros sectional shape are practically impossible to grow in a horizontal furnace. The method described herein can be used to grow monocrystalline aluminium crystals with any desired orientation or cro sectional shape.

548.522 : 551.578.4

2990. THE ELECTROSTATIC FIELD AND THE SYMMETRY OF SNOWFLAKES. R.A.Schrack.
J. Washington Acad. Sci., Vol. 48, No. 9, 273-5 (Sept., 1958).

The basic assertion of the present theory is that the electrostatic field of the charged snow crystal has a controlling influence o the shape of the crystal during its growth. The influence of the electrostatic field is exerted through field-induced surface migrati which causes symmetrical growth as the continuous lowest energy state. The theory takes into account the observed variations in sig and magnitude of the charge on snowflakes. The mode of development of snowflakes having shape symmetry corresponding to the two-dimensional rotation group D_6, as well as to the less commonly observed D_2, D_3, and D_{12} shapes, is indicated. The infinite variety of symmetrical forms is seen as resulting from the random nature of water accretion by the flake.

548.53

2991. TWINNED EPITAXY OF COPPER ON COPPER.
T.H.Orem.
J. Res. Nat. Bur. Stand., Vol. 60, No. 6, 597-608 (June, 1958).

A study of the X-ray diffraction patterns of copper electrodeposited on copper monocrystals having surfaces parallel to the cubic, dodecahedral, and octahedral planes shows an interesting relationship between electrodeposit and base crystal. At the current densit used for electrodeposition, the electrodeposit on the surface parallel to the dodecahedral plane was a monocrystalline continuation of the orientation of the base crystal in every respect. The electrodeposit on the surface parallel to the octahedral plane was a highly preferen tially oriented polycrystalline electrodeposit made of microcrystals some of which continued the orientation of the base crystal, whereas others were twinned with respect to the surface plane of the base crystal. In the case of electrodeposition on the surface parallel to the cubic plane, the electrodeposit was also a highly preferentially oriented polycrystalline electrodeposit made up of microcrystals, some of which continued the orientation of the base crystal, whereas others bore a twin relationship to the close-packed planes of the bas crystal.

548.574

2992. ETCHING OF FLUORITE. N.S.Pandya and J.R.Pandya.
Curr. Sci., Vol. 27, No. 11, 437 (Nov., 1958).

Triangular pits on two (111) cleavage faces of fluorite, obtained by etching in H_2SO_4, were randomly distributed but oriented in definite directions, and showed point-to-point correspondence in the two faces.
J.Franks

548.574

2993. MACROSCOPIC SURFACE STRUCTURES FORMED ON BORON UPON SOLIDIFICATION. C.P.Talley.
Nature (London), Vol. 182, 1593 (Dec. 6, 1958).

Various pit formations are observed after rapid cooling from 2000°C. These are similar in form to pits obtained by the acid etching of solid crystals and include a hexagonal spiral, a pyramidal pit, and an oval plateau.
C.A.Hogarth

X-RAY CRYSTALLOGRAPHY

548.73/.74

X-RAY AND ELECTRON INVESTIGATION OF MATERIALS. See also the Section entitled "STRUCTURE OF SOLIDS".

548.736.3

2994. CRYSTAL STRUCTURE OF Ni_3B AND Co_3B.
S.Rundqvist.
Acta chem. Scand., Vol. 12, No. 4, 658-62 (1958).

Ni_3B and Co_3B are isostructural with cementite (Fe_3C). A single-crystal structure determination of Ni_3B was made. Some properties of the cementite structure are discussed.

548.736.3 : 537.226.2 : 535.399

CRYSTAL STRUCTURE OF MgF_2. See Abstr. 2239

548.736.4 : 537.312.5

CRYSTAL STRUCTURE OF CAESIUM PLUMBOHALIDES. See Abstr. 2341

GEOPHYSICS

550.312 : 526.7

2995. THE DETERMINATION OF THE VALUE OF G IN THE PHYSICAL INSTITUTE [MONTEVIDEO]. C.A.de Torres Balsami.
Bol. Fac. Ingen. Montevideo, Vol. 6, No. 6, 187-92 (Oct., 1957).
In Spanish.

An accurate determination of g has already been made at a standard point in the city, and by means of a Worden No. 159 gravimeter a value has been obtained for a point outside the building. This same instrument is now used to measure the change on moving to a certain point inside the building; this change is a decrease of 0.00846 cm/sec^2, giving a value of 979.74482 cm/sec^2 for the point inside the building. This value has been corrected for the drift of the instrument. There is a photograph, but no constructional details are given. N.Corcoran

550.312 : 526.76

2996. AN INVESTIGATION INTO THE CALIBRATION OF GRAVITY METERS. R.L.G.Gilbert.
Geophys. J., Vol. 1, No. 4, 330-40 (Dec., 1958).

Gravity observations made with gravity meters over large gravity ranges have shown the instruments to be less satisfactory than is desirable. Figures are given showing the errors which have been found using three gravity meters under various field procedures and some possible causes of error are discussed. The scale constants of the gravity meters are shown to change substantially with time, and a system is described which was built into one gravity meter in order to check the scale constant at any time. The results obtained from this device are tabulated and discussed; no satisfactory mechanism has been produced to explain the change in scale-constant, and the calibration device has some use, although not so much as had been hoped. It is concluded that for the accurate measurement of large gravity differences careful operation of the gravity meters is essential, the calibration of the instrument being checked regularly; and that pendulum measurements may be preferable for the measurement of very large gravity differences.

550.312 : 525.3

2997. USE OF ARTIFICIAL SATELLITES TO EXPLORE THE EARTH'S GRAVITATIONAL FIELD: RESULTS FROM SPUTNIK 2 (1957 β). R.H.Merson and D.G.King-Hele.
Nature (London), Vol. 182, 640-1 (Sept. 6, 1958).

Details are given of a procedure whereby accurate observations of satellite orbits may be used to obtain, indirectly, knowledge of the earth's gravitational field. Results of measurements of the rate of rotation of the orbital plane of satellite 1957 β show that this increased over the first $4\frac{1}{2}$ months of the satellite's life at a rate which agreed very well with the theoretically expected variation, but the observed values at any time are consistently lower than the theoretical values. The discrepancy could be removed by altering the value of one of the constants assumed in the theory. G.M.Brown

550.341

2998. ON THE GENERAL PLANE PROBLEM OF PLASTICITY AND ITS GEOPHYSICAL SIGNIFICANCE. S.C.Das.
Canad. J. Phys., Vol. 37, No. 1, 63-74 (Jan., 1959).

The results obtained from the fault plane studies made in the Dominion Observatory show strong horizontal displacements in the focus of earthquakes. This indicates a marked deviation from the existing theories of geotectonics. To account mathematically for them, the study of the plane problem of plasticity is proposed using as yield condition a general functional relation between the stresses. The differential equations involved in the problem are of non-linear type. For solutions these are replaced by a different set of completely equivalent equations expressing variations along families of curves, known as characteristics, across which certain derivatives may be discontinuous under suitable boundary conditions. Physically, the elastic-plastic (or rigid-plastic) interface is taken as a characteristic curve which is a fundamentally unknown thing, and which must be ascertained from symmetry of the problem or by proper experimentation. Investigations in this direction are now being done in connection with the International Geophysical Year. Meanwhile here we discuss the various relatively modern methods of linearization of the stress equations. Each of them essentially deals with transformations of co-ordinates, depending upon the form of the yield condition, though in every case the generalized nature is maintained.

550.38 : 538.711

2999. MEASUREMENT OF THE EARTH'S MAGNETIC FIELD WITH A RUBIDIUM VAPOR MAGNETOMETER.
T.L.Skillman and P.L.Bender.
J. geophys. Res., Vol. 63, No. 3, 513-15 (Sept., 1958).

An instrument which uses "optical pumping" techniques to measure the earth's magnetic field has been constructed. Absolute values of the field were measured and compared with values obtained from the magnetograph records of the observatory.

550.38.08

3000. ON THE INFLUENCE OF THE SELF-INDUCTION OF COILS WITH A MAGNETIC CORE USED FOR THE RECORDING OF RAPID VARIATIONS OF THE EARTH'S MAGNETIC FIELD.
G.Grenet.
Ann. Geophys., Vol. 13, No. 3, 249-51 (1957). In French.

An analysis of a circuit consisting of an iron-cored coil in series with a shunted galvanometer. The problem is presented in terms of an equivalent circuit and it is shown that only four constants are required to characterize the circuit. A.E.De Barr

550.384.3

3001. THE RELATIONSHIPS BETWEEN THE SECULAR CHANGE AND THE NON-DIPOLE FIELDS. K.Whitham.
Canad. J. Phys., Vol. 36, No. 10, 1372-96 (Oct., 1958).

Using airborne, ground, and repeat magnetic observations in Canada, compiled in the isomagnetic and isoporic charts for epoch 1955.0, the drift and decay contributions of the non-dipole field to the observed secular variation were estimated. The drift rates which produce the minimum residual secular variation were found to be unusually small. It is then confirmed, using the longitude displacement method and isomagnetic data only, that the westward drift of the non-dipole field in recent years in Canada is significantly smaller than the world-wide average. These results clearly demonstrate the large local fluctuations which occur in westward drift. The two different methods were applied to obtain relationships between the Gaussian coefficients in the spherical harmonic analyses of the earth's main field and the secular variation. Calculations show that both methods give the accepted world-wide average value of westward drift, and in general decay terms are unimportant.

ATMOSPHERE . IONOSPHERE

551.508.26

3002. A THERMOMETER FOR HIGH-SPEED AIRCRAFT.
D.D.Clark.
J. sci. Instrum., Vol. 35, No. 12, 433-9 (Dec., 1958).

The principles of aircraft thermometer design are reviewed, from which it is deduced that the conical head design possesses distinct advantages over other kinds of thermometer head in high-speed flight. The construction of the thermometer is described and the results of wind-tunnel tests are quoted and discussed. The lag and radiation errors are calculated and the extension of the use of the thermometer to supersonic flight is discussed. An outstanding feature of this termometer is the remarkable constancy of the recovery factor over a range of Mach numbers from 0.2 to 0.9 and its rapid response to temperature changes, the lag coefficient being of the order of 2 sec.

551.508.71 : 533.275

A HIGHLY SENSITIVE HAIR HYGROMETER. See Abstr. 2143

551.51 : 538.566.2 : 532.517.4

SPACE—TIME CORRELATIONS IN STATIONARY ISOTROPIC TURBULENCE. See Abstr. 2127

551.510.3

3003. COMPARISON OF HIGH-ALTITUDE ROCKET AND SATELLITE DENSITY MEASUREMENTS.
H.E.LaGow and R.Horowitz.
Phys. of Fluids, Vol. 1, No. 6, 478-9 (Nov.-Dec., 1958).

Atmospheric density measurements obtained with rocket-borne ionization gauges are compared with U.S.A. and U.S.S.R. satellite-drag density measurements. There is no significant disagreement between the results obtained by the two methods once atmospheric variations are taken into account.

551.510.535

3004. A NEW F-LAYER MODEL. O.Burkard.
Geofis. pura appl., Vol. 37, 145-64 (1957/II).

The model originally constructed for the F1-layer is adapted to enable an investigation of both F-layers. Essential premises are: the ionization of a single constituent of the atmosphere by monochromatic radiation; a positive temperature gradient in the F1-region; a temperature independent of height in the F2-region; a negative temperature gradient above the height of the F2-electron-peak; and strong heating in the F2-region during the daytime. It is further assumed that the rate of electron loss in the F1-layer is proportional to the square of the density of the electrons, and in the F2-layer is directly proportional to this density. It is also assumed that this electron loss is proportional to the power k of the pressure p, and to the power n of the absolute temperature T, as assumed in the original F1-layer model. The assumptions regarding the temperature conditions are essential to an understanding of the transition from static to dynamic conditions observed in the F2-layer. During the night and in the morning, the F2-layer can be treated as a static problem, movement of air-masses being of no great importance. Later in the day, however, a labile stratification of air-masses gives rise to such movement that the F2-layer can only be handled as a dynamic problem. Numerous observational data are referred to in order to prove the practicability of the new model and, with the help of this model, to justify new assertions. It has been possible for example, to calculate the yearly temperature variation at a constant level in the F1-layer. A critical survey of other models described recently is presented.

551.510.535

3005. MODEL OF THE IONOSPHERE. O.Burkard.
Naturwissenschaften, Vol. 45, No. 21, 507 (1958). In German.

By combining data from lunar echo experiments and Russian rocket and satellite flights, the distribution of electrons above the level of maximum F2-region ionization density is shown to compare closely with a theoretical curve previously derived by the author (see preceding abstract). H.J.A.Chivers

551.510.

3006. THE DIURNAL- AND SUNSPOT-CYCLE VARIATION OF THE LAYERS E, F1 AND F2 OF THE IONOSPHERE AS OBSERV IN NORWAY DURING THE PERIOD 1932-1956. B.Mæhlüm.
Geofys. Publ., Vol. 20, No. 6, 14 pp. (1958).

Standard methods were applied in order to study the diurnal variation of the critical frequencies of the E- and the F1-layers, the seasonal and sunspot-cycle variation of the critical frequencie of the E-, F1- and F2-layers and the transmission factor (M 3000 The study is based mainly upon observations obtained at Kjeller a at Tromsø, although for part of the study some recent observation from Spitzbergen are also included. In order to study the variatio of the critical frequencies of the E-, F1- and F2-layers with suns activity, observations obtained at the same time of the day and the same month for all years were selected. Reasonably good linear correlation between the critical frequencies and the 13-monthly running mean of the sunspot number, W, were obtained. The sensitivity of the critical frequency to sunspot activity for the E- and F1-layers showed a clear maximum in the summer, in agreement with the Chapman theory. The noon values of the sensitivity for th F2-layer showed a minimum in the summer both at Kjeller and at Tromsø. The diurnal variations of f_0E and f_0F1 are found to obey reasonably a $\cos^n\chi$ law, and the exponent n is found to vary with season and latitude. The spread of the daily observations from the monthly median values was studied by means of the observed quart ranges deduced from the observed values of f_0F2 at Kjeller for thos years when the observations have been made by the NDRE. The quartile range seems to increase with the magnitude of the monthly median value and with sunspot number. A greater spread was observed by night than by day. The correlation between the transmis sion factor (M3000)-F2 and the sunspot number W was studied for each month separately, and was found to be rather good. A study o the seasonal variation of the transmission factor concludes the wor

551.510.53

3007. IONOSPHERIC MEASUREMENTS MADE AT HALLEY BAY
W.H.Bellchambers and W.R.Piggott.
Nature (London), Vol. 182, 1596-7 (Dec. 6, 1958).

An analysis of the initial results from the ionospheric sounding equipment at Halley Bay is given. Absorption controlled by corpuscular radiation during the polar winter has a maximum at 0400 L.M.T. (30°W). The occurrence of auroral radar echoes, mainly from higher latitudes, shows a similar diurnal maximum which peaks a few hours earlier. Coincident with excessive ionospheric absorption and zenithal aurorae, weak reflections from an ionized layer at about 80 km have been obtained. The diurnal variations of f_0F_2 show: (i) a peak near noon in the winter in spite of the comparitive absence of photo-ionization, (ii) a seasonal maximum near noon at the equinoxes, and (iii) a minor increase around midnight during the summer. The results demonstrate the predominating influence of ionization transport phenomena over that of recombination processes. H.J.A.Chivers

551.510.535 : 621.396.8

3008. ELECTRON DENSITY PROFILES IN THE IONOSPHERE DURING THE I.G.Y. R.L.Smith-Rose.
Proc. Inst. Radio Engrs, Vol. 46, No. 11, 1874 (Nov., 1958).

Electron density v. true height profiles have been calculated from ionograms using a digital computer for observatories at Slough Ibadan, Singapore and Port Stanley. Profiles are being calculated for each hour of the day, four days per month over the period from July 1957 to December 1958. A specimen table showing density variation with time and height is given for the F_2 layer, the method of computation being that of Abstr. 2067 (1958). Microfilm copies of the tables will be sent to the four I.G.Y. ionospheric data collection centres on completion. G.D.Sims

551.510.535

3009. THE ELECTRIC CONDUCTIVITY OF THE IONOSPHERE.
G.Grenet.
Rev. Fac. Sci. Univ. Istanbul C, Vol. 21, No. 3, 181-3 (July, 1956). In French.

It is necessary to take into account the skin effect when considering the ionospheric properties and it is shown that perturbations of a few hundred cycles cannot penetrate the ionosphere and slower perturbations should penetrate by night, but not by day. J.M.Hough

551.510.535

RADIO-WAVE PROPAGATION IN THE IONOSPHERE. See also the Section entitled "ELECTROMAGNETIC WAVES AND OSCILLATIONS".

551.510.535 : 537.56

PLASMA MOTIONS INDUCED BY SATELLITES IN THE IONOSPHERE. See Abstr. 2441.

551.557 : 523.164.85

3010. ANALYSIS OF METEORIC BODY DOPPLER RADAR RECORDS TAKEN DURING A GEMINID SHOWER PERIOD. M.Srirama Rao.
Canad. J. Phys., Vol. 36, No. 7, 840-54 (July, 1958).

The determination of the prevailing wind in the 80-100 km region of the upper atmosphere by a new method, involving the simultaneous use of a C.W. Doppler radar at 30.02 Mc/s and three-station pulsed radars at about the same frequencies, is presented in this paper. This method involves the determination of the exact location of each observed meteor train and the component of the velocity of its horizontal drift in the direction of the azimuth from Ottawa. A 40 min period during the Geminid shower on the night of December 10-11, 1948, was selected for this investigation. Theory for the analysis of the body Doppler records is briefly outlined. The prevailing wind speed obtained from the body Doppler frequencies (f_d) is 54 m/s. The observed linear variation in the average f_d with time, in the case of each meteor, was caused by the effective point of reflection drifting along its train towards the maximum echo duration level. Periodic fluctuations of f_d of the order of 1-3 c/s, on the average, have also been observed. The above two phenomena can be explained from a postulate of atmospheric turbulence on a scale of about 1 km or above.

551.574.1 : 532.529.7

3011. THE COLLISION EFFICIENCY OF SMALL DROPS. L.M.Hocking.
Quart. J. Roy. Meteorol. Soc., Vol. 85, 44-50 (Jan., 1959).

The forces on two moving spheres are found from the Stokes equations of motion, full allowance being made for the mutual interference of the flows round the spheres, and the relative trajectories when they are falling under gravity are calculated so that the collision efficiency E can be found. The values of E are determined for drops of radius up to $30\,\mu$ colliding with droplets of any smaller size. The results differ widely from those found by Pearcey and Hill (1957) and it is suggested that the reason for the discrepancy is that the motion of the spheres when they are close together is of great importance in determining E. The results also differ from those found by Schotland and Kaplin (1956). Their experiments did not model the ratio of the density of the spheres to that of the medium through which they are falling and since it is shown that this factor is of importance, their results are not considered applicable to water drops falling in air.

551.576.1

3012. MEASUREMENTS OF THE SIZE AND ELECTRIFICATION OF DROPLETS IN CUMULIFORM CLOUDS. B.B.Phillips and G.D.Kinzer.
J. Meteorol., Vol. 15, No. 4, 369-74 (Aug., 1958).

The size and the free electric charge of more than 6000 individual natural cloud droplets were measured. The measurements were made in stratocumulus clouds and in thunderstorm-associated clouds. Stratocumulus clouds with fair-weather electric fields were found to have approximate Gaussian-charge distributions symmetric about zero charge. The magnitude and distribution of charge observed on these non-storm clouds approach values described recently by Gunn (1956) in his theory of aerosol electrification by the diffusion of environmental light ions. Thundercloud droplets were highly electrified and within given cloud volumes the droplets were charged entirely positive, entirely negative, or fractionally positive and negative.

551.578.41 : 548.522

ELECTROSTATIC FIELD AND THE SYMMETRY OF SNOWFLAKES. See Abstr. 2990

551.59 : 532.5 : 538.3

3013. LARGE AMPLITUDE HYDROMAGNETIC WAVES ABOVE THE IONOSPHERE. A.J.Dessler.
J. geophys. Res., Vol. 63, No. 3, 507-11 (Sept., 1958).

Arguments are presented for the existence above the ionosphere of very large amplitude hydromagnetic waves. Crude estimates show that it is not unreasonable to expect hydromagnetic waves above the ionosphere to have an amplitude of the order of 10^2 times the amplitude of geomagnetic fluctuations observed at the surface of the earth. It is suggested that these hydromagnetic waves produce the irregularities in electron density which are responsible for radio-star scintillation. It is also suggested that the large amplitude hydromagnetic waves are responsible for producing the high intensity particle radiation observed above about 1000 km by Van Allen et al.

551.594

3014. AIRBORNE MEASUREMENTS OF ATMOSPHERIC ELECTRICITY. J.H.Kraakevik and J.F.Clark.
Trans Amer. Geophys. Un., Vol. 39, No. 5, 827-34 (Oct., 1958).

An experimental investigation of the variations of atmospheric electric quantities in space and time was conducted. A review of past measurements reveals several inaccuracies and inconsistencies which stimulated the investigation. The simultaneous measurement of both polar conductivities, of potential gradient, and of several meteorological quantities and the derivation of other atmospheric electric variables, are described. Altitude "profiles" of conductivity and potential gradient up to 6 km obtained on a representative sounding over the Chesapeake Bay show a secondary exchange layer above the more common surface exchange layer. The space-charge density profile exhibits positive charge concentrations at the tops of these layers, near the bases of the associated temperature inversions. Upward convection of positive space charge causes the computed conduction-current density within the exchange layers to be some 40% higher than its relatively constant value above the layers. The product of columnar resistance and current density, employed by previous workers to obtain atmospheric potential, provides erroneous values whether the conduction current near the Earth's surface or the average value over the entire altitude range is used. On the basis of a 6 km atmospheric potential of 327 kV obtained from the integrated potential gradient, the true extrapolated total potential of the high atmosphere is 341 kV at a time near the diurnal maximum.

551.594.221

3015. INTRACLOUD LIGHTNING DISCHARGES. L.G.Smith.
Quart. J. Roy. Meteorol. Soc., Vol. 83, 103-11 (Jan., 1957).

Slow electric-field changes produced by lightning discharges within clouds were recorded simultaneously at two stations 13.2 km apart. It is found that the same cloud discharge may give field changes of different types (simple and complex), or of opposite sign (reversal effect), or both, at the two stations. Two main types of complex slow field change are described. The interpretation of slow field changes is discussed in terms of movement of charge. It is shown that, in the most frequent case, the cloud discharge involves the raising of negative charge.

551.594.5

3016. PARALLACTIC MEASUREMENTS ON AURORAE OVER CHURCHILL, CANADA. D.J.McEwen and R.Montalbetti.
Canad. J. Phys., Vol. 36, No. 12, 1593-600 (Dec., 1958).

Height measurements on the lower edges of homogeneous and rayed arcs and bands are reported from 404 photographs taken of aurorae over Churchill (58.8° N., 94.2° W) during the winter of 1957-58 as part of the I.G.Y. programme. The frequency distribution in height of 1975 points measured shows a double peak at 101 and 107 km, and a mean height of 104.8 km. The chief factor affecting height of aurora appears to be that of intensity; the mean height of weak aurorae was found to be 107.7 km, while that of strong aurorae was 100.1 km. No difference in mean height of aurorae before and after midnight was observed. Tidal effects in the upper atmosphere did not appear to affect auroral height greatly. The mean heights of aurorae measured during high and low tide conditions showed no appreciable difference. A mean orientation of 105.5° magnetic azimuth was measured for auroral arcs. Auroral motions with speeds up to 2500 m/sec were observed.

551.594.5

3017. A MAN-MADE OR ARTIFICAL AURORA. A.L.Cullington.
Nature (London), Vol. 182, 1365-6 (Nov. 15, 1958).

A display of brightly coloured rays and arc, observed at Apia in the Central Pacific area on August 1, 1958, which at first was thought to be an Aurora Australis, is believed to have been caused by the explosion of a nuclear bomb at a height of 100 miles above Johnston Island. The explosion also initiated abnormal geomagnetic activity over a localized area adjacent to the explosion site, whose sudden commencement coincided with the firing of the nuclear charge.

D.R.Barber

551.594.5 : 523.164.8

RADAR ECHOES FROM AURORA. See Abstr. 2005

551.594.51 : 523.59

3018. RECENT PROGRESS RELATING TO THE STUDY OF AURORAE AND KINDRED PHENOMENA. L.Vegard.
Geofys. Publ., Vol. 20, No. 4, 16 pp. (1958).

From auroral studies it was found that the structure of the ionosphere, the zodiacal light, the solar corona and the bundles of electric rays which produce aurorae and most magnetic disturbances is due to the photoelectric effect of solar X-rays of various frequencies and different distributions. The electric bundles producing the aurorae are formed by photoelectrons from the sunspot area and neutralized by positive ions, mainly protons. In the years 1939-41 it was found, by means of Doppler effect, that the bundles carried protons with velocities amounting to at least 2×10^8 cm/sec. The neutralized bundles led to an auroral theory essentially similar to the Birkeland—Störmer theory, but variation of the proton flux in the bundle led to many consequences which could be verified with spectral studies of the aurorae. Thus variations with latitude and altitude were found in accordance with theory. From the fact that protons and electrons give essentially different spectra a number variability effects could be explained. Thus the red aurorae of ty A and B were found to be due to protons and electrons, respectivel Recently detected enhancements of atomic lines were found to be d to increase in the relative proton flux. The velocity of protons is a rule much smaller than that of the electrons. Consequently the bundle carries a surplus of negative electricity into the atmospher where it produces electric and magnetic disturbances of various kinds, and gives the earth a negative charge. Temperature measu ments from N_2^+ bands corresponding to altitudes of several hundre km gave no indication of any increase of temperature with altitude

BIOPHYSICS

PHYSIOLOGICAL PHYSICS

591.176 : 535.371

ON THE FLUORESCENCE OF THE SKIN. See Abstr. 2217

612.843

3019. RESEARCH INTO THE DYNAMIC NATURE OF THE HUMAN FOVEA → CORTEX SYSTEMS WITH INTERMITTENT AND MODULATED LIGHT. I. ATTENUATION CHARACTERISTICS WITH WHITE AND COLORED LIGHT. H. de Lange Dzn.
J. Opt. Soc. Amer., Vol. 48, No. 11, 777-84 (Nov., 1958).

A generally known method for the dynamic investigation of any linear system is recalled to mind. Applied to the visual organ with sinusoidally modulated light, the dynamic nature of the system fovea → brightness perception is embodied in attenuation characteristics, by plotting the ratio output amplitude over input amplitude against frequency at constant mean luminance. This manner of investigation, first applied in previous papers with white light, is expanded over a greater part of the range of cone vision and is continued with coloured light. The existing theories on flicker fusion provide no explanation for the shape of the attenuation characteristics obtained with the experiments and calculated from investigations of other authors.

612.843

3020. RESEARCH INTO THE DYNAMIC NATURE OF THE HUMAN FOVEA→CORTEX SYSTEMS WITH INTERMITTENT AND MODULATED LIGHT. II. PHASE SHIFT IN BRIGHTNESS AND DELAY IN COLOR PERCEPTION. H. de Lange Dzn.
J. Opt. Soc. Amer., Vol. 48, No. 11, 784-9 (Nov., 1958).

It is shown that the well-known residual brightness flicker just above the colour-flicker limit with heterochrome flicker photometry can be brought down to zero by introducing an external phase correction in one of two light beams sinusoidally modulated 100% in antiphase and simultaneously presented to the eye. The phase correction is found to be a function of luminance, colour difference, and frequency. From the attenuation characteristic of the colour system it is found that the extra delay in colour perception at 595 mμ is caused by a single integration process with a time constant of 120 msec at high luminance; at low luminance a triple integration process occurs with the same time constant.

612.843.32

3021. QUANTITATIVE RELATION BETWEEN CHROMATICITY DIFFERENCES AND LUMINANCE DIFFERENCES.
E.M.Lowry and J.J.DePalma.
J. Opt. Soc. Amer., Vol. 48, No. 11, 820-7 (Nov., 1958).

In general, when two or more stimuli are simultaneously presented to the eye, the phenomenon referred to as "contrast" results. This contrast will be produced by differences between the stimuli, in either luminance or chromaticity, or both. Making use of the fact that veiling luminance, commonly called "glare", destroys contrast, the authors propose the use of veiling luminance as a means for specifying the equivalence between chromaticity differences and luminance differences. The results of measurements on a large number of samples are presented, together with a practical applica tion of the proposed method to the problem of determining how muc chromaticity differences contribute to the judgment of graininess in photographic materials.

612.843.6

3022. STUDY OF VISUAL ACUITY DURING THE OCULAR PURSUIT OF MOVING TEST OBJECTS. I. INTRODUCTION.
E.Ludvigh and J.W.Miller.
J. Opt. Soc. Amer., Vol. 48, No. 11, 799-802 (Nov., 1958).

Visual acuity may be measured during the voluntary ocular pursuit of moving test objects. This visual function has been referred to as dynamic visual acuity. The apparent movement of the test object is produced by rotating a mirror in the desired plane of pursuit by means of a wheel and disk type variable speed drive. The range of angular velocities utilized is from 10 to 170 deg/sec at the noda point of the tested eye. It is shown that visual acuity deteriorates markedly and significantly as the angular velocity of the test object is increased. It is shown further that the relationship between visual acuity and the angular velocity of the test object may be described satisfactorily by the semiempirical equation $Y = a + bx^3$. It also is pointed out that individuals possessing similar static acuity may differ significantly in their dynamic acuity. The possible causes for the observed deterioration of acuity are discussed and it is concluded that imperfect pursuit movements of the eye result in a continued motion of the image on the retina. This motion results in reduced intensity contrast, which is a factor in producing loss in acuity.

612.843.63

3023. STUDY OF VISUAL ACUITY DURING THE OCULAR PURSUIT OF MOVING TEST OBJECTS. II. EFFECTS OF DIRECTION OF MOVEMENT, RELATIVE MOVEMENT, AND ILLUMINATION. J.W.Miller.
J. Opt. Soc. Amer., Vol. 48, No. 11, 803-8 (Nov., 1958).

It was demonstrated that the manner in which visual acuity deteriorates as the angular velocity of the test object increases is similar regardless of whether the motion is produced by moving the target vertically, horizontally, or by rotating the observer in a horizontal plane. It was shown also that the semiempirical equation $Y = a + bx^3$ describes satisfactorily these three types of movement. It was pointed out that individuals having a low acuity threshold in the vertical plane of movement will be likely also to have a low threshold in the horizontal plane. It was shown that although 5 to 10 footcandles may be sufficient illumination when the test object is stationary, visual acuity is substantially benefited by increases up to 125 footcandles when the observer is rotated. This corroborates earlier findings reported by Ludvigh.

LIST OF JOURNALS

The following list supplements the List of Journals published with the Index to Volume 61 (1958). Reprints of the List of Journals can be obtained from The Institution of Electrical Engineers, Savoy Place, London, W.C.2, price 2s.0d. post free.

The addresses given are believed to be correct at the date of publication, but no responsibility can be accepted for errors.

Ciel et Terre	Ciel et Terre. 3 Avenue Circulaire, Uccle-Brussels.
Izv. Akad. Nauk SSSR, Ser. geofiz.	Izvestiya Akademiĭ Nauk SSSR. Seriya Geofizicheskaya. Moscow.
J. Fluid Mech.	Journal of Fluid Mechanics. Taylor and Francis, Red Lion Court, Fleet Street, London, E.C.4.
Quart. J. Mech. appl. Math.	Quarterly Journal of Mechanics and Applied Mathematics. Oxford University Press, Amen House, Warwick Square, London, E.C.4.
Rev. gen. Chem. de Fer	Revue Générale des Chemins de Fer. Dunod, 92 rue Bonaparte, Paris 6.
Trans Soc. Instrum. Technol.	Transactions of the Society of Instrument Technology. 20, Queen Anne Street, London, W.1.
Utilis. Res. Rep. Electricity Council	Utilisation Research Report. The Electricity Council. Winsley Street, London, W.1.
Wiss. Z. Hochsch. für Schwermaschinenbau Magdeburg	Wissenschaftliche Zeitschrift der Hochschule für Schwermaschinenbau Magdeburg. Am Krökentor 2, Magdeburg.
Z. Krist.	Zeitschrift für Kristallographie. Holbeinstrasse 25-27, Frankfurt am Main.

ERRATA

Author Index (1958) p. 949, column 1 : for "Ramsey,J.F." read "Ramsey,N.F."

February, 1959, author index: after "E.N.Bazley" delete "1844" and insert new entry "N.W.Bazley, 1844".

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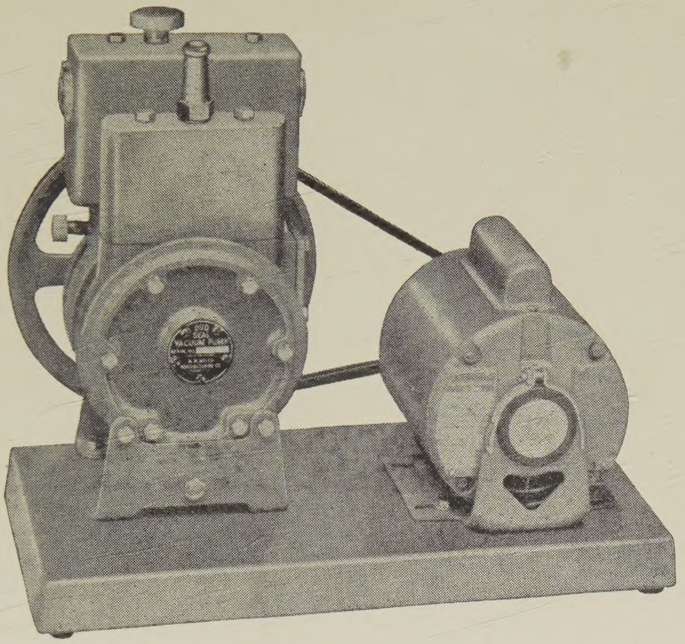

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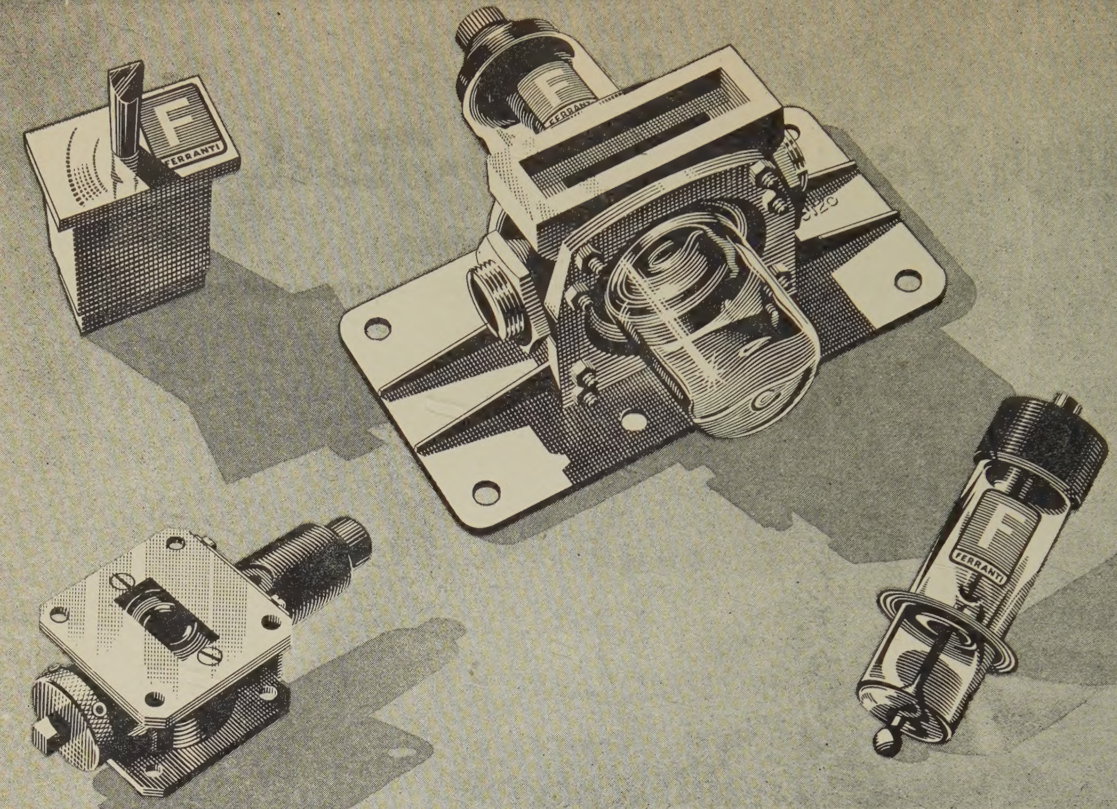

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